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ENTOPTIC PHENOMENA ASSOCIATED WITH THE RETINA

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ENTOPTIC phenomena may be induced by structures in the retina and adjoining chorio-capillaris or by structures anterior to the retina. Only the first of these groups will be considered in this paper. If it is assumed that the most distal part of the layer of rods and cones, namely, the outer segment, is the receptive structure for visible form, it is theoretically possible for this part of the rods and cones to see in some measure the shadows of all structures on or near the optic axis in front of it; and, since the distal part of the rods and foveal cones shows no distinct asymmetry of structure, there seems no good reason why this receptive part of the retina should not see objects behind it if these are sufficiently illuminated for the purpose. This power of looking backwards the retina possesses.

Retinal Vessels and Macula

The most easily demonstrable entoptic phenomenon associated with the retina is the retinal vessels themselves. The shadows of these are momentarily seen when light is thrown at a slight angle on the retina. By constant movement of the light they can be kept in view. The more parallel the beams of light falling on

the retina the more perfect is the picture of the retinal vessels perceived. A light source placed near the sclerotic, which sends out light rays in all directions, shows only the larger vessels, whereas an arrangement offering parallel rays to the retina demonstrates also the capillaries around the vessels. The distribution is seen to be the same as in the central part of an injected retina. The explanation of their visibility (*cf.* Wheatstone) usually accepted is that the obliquity of the light falling on the retina used to make them visible causes shadows to fall on the rods and cones unaccustomed normally to receive them. The explanation is not wholly satisfactory (*cf.* Jago). Thus the simplest way of viewing the central retinal vessels entoptically is to cause eccentric rotation of a pinhole in front of the pupil whilst gazing at a uniformly lit surface such as the sky. The minimal rapidity of rotation necessary to bring out the vessels well is about four per second. Cessation of the movement at any point causes the perception of the vessels to disappear immediately. It would thus seem that successive induction plays an important part.

Besides the retinal vessels the macula is seen at the same time, most clearly by the pin-hole method. Viewed by this method it has the appearance of an aster-like figure with somewhat curved lines running from a depressed centre. The lines are probably the curved nerve fibres originating in the foveal cones. They are the only structures of the retina, apart from the retinal vessels, which are distinctly seen in front of the rods and cones. The reason that other structures of the retina are not perceived by these methods is due to the overcrowding and superposition of cells in the different layers outside the macula so that no outline picture of them is possible. The blood vessels alone are perceptible because being less numerous, less transparent and less superposed, they exhibit more definite contours. That the foveal nerve fibres are seen is doubtless due to the absence of other structures and to the regularity of the narrow bundles of fibres giving visible outlines.

Chorio-capillary Circulation

A retro-retinal circulation, probably limited to the chorio-capillary circulation, may be indistinctly perceived, after experience of its normal appearance has been gained, by gazing intently, with relaxed accommodation, at any brightly lit uniform field. The luminous points to be referred to later are earliest and most easily seen; but on continuing the gaze these may disappear and be replaced by a darkened field in which circulation is observed. I first saw the chorio-capillary circulation whilst under the influence of mescaline, but it was only recognized as such after prolonged investigation with the microscope. If a microscope is arranged

to give the best lighting for resolution for any particular objective and the brightly lit field be gazed at for a short time, the field may become suddenly more or less dark. In a perfect observation it becomes very dark. Careful examination will then show a surging circulation in irregular sinuses, somewhat fern-like in appearance, of a dark reddish-grey colour, bounded by a black ground meshwork and covering the whole field. Over the field may also be seen innumerable fine granules of black pigment; but not always. The effect lasts only a few seconds but it may usually be repeated several times, and after considerable practice many times. Certain conditions facilitate the observation. It is imperative that anything fixing attention should be absent; hence the microscope should be optically clean and the source of light well shaded from the eyes. As illuminant for these observations the oil lamp with bull's eye condenser possesses advantages. The unused eye should be kept open and directed towards a black background about 25 cm. away. An ordinary camera dark cloth may be used to cover the bright parts of the microscope and form the requisite background. In place of this background the eyeshade sold for use with the microscope may be employed, but is less efficient. Capped eyepieces, owing to the greater protection they afford, are better than the ordinary kind; and the long tube microscope is better than the short tube one owing to the greater comfort of observation and the more suitable distance of the projected visual plane. A low power eyepiece is advisable and a to-and-fro movement about the eye point is often helpful in initiating the change to darkground effect. The experiment requires a partially dark-adapted eye and is best made in an evening. A certain but small intensity of general lighting is, however, desirable. That obtained through the door from an ordinarily lit hall in an otherwise unlit room is usually sufficient.

When the retro-retinal circulation has been perceived, it can easily be projected on to a dark board at the usual distance of 25 cm. from the unused eye and could easily be drawn in outline were it not that the circulation is in turbulent motion and the outline constantly changing owing largely to its considerable depth. Perhaps the nearest representation to its appearance is that of a bunch of fern fronds blown by the wind. Curiously, the unused eye seems to be projecting the picture, since any disturbance of the vision of that eye causes the picture to disappear; but this is not always the case, since the retro-retinal circulation can be observed when the unused eye is closed. The circulation cannot, however, always be observed especially when the microscope is used. Occasionally only the pigment layer of the retina is seen; sometimes, even after considerable experience has been gained, no retro-retinal structure whatever can be focused, a difficulty particularly noticeable in anxiety states.

Provided the conditions of uniform illumination to one eye and an appropriate dark visual field to the other eye be maintained other arrangements may be used. A large short-focus lens placed slightly within its image plane from a brightly lit opal surface arranged in a blackened tube affords an equally easy method of observation, but the picture has not seemed to me so sharp as with the microscope. The circulation may also be observed in an interesting way by means of the slit-lamp as ordinarily used in a dark room. If a board covered with a black cloth be placed in front of the unilluminated eye and be tilted towards the slit-lamp to get the most suitable lighting, a dark tumultuous circulation may be discernable on it and by movement of the slit-lamp the Purkyně figures may be observed in the illuminated eye. The two circulations, so completely different, may thus be observed at the same time by the two eyes. The perception of the chorio-capillaris as a pressure phosphene will be referred to later.

The retro-retinal picture, even of the circulation only, is not always the same, because it is not always possible to get full resolution; and apart from the distance to which the picture may be projected, there seems at times to be some difference in the magnification under which it is observed. This difference is, perhaps, most noticeable when the circulation is seen as a pressure effect.

Retinal Pigment

Besides the chorio-capillary circulation pigment particles may also be seen at the same time covering both circulating blood and ground meshwork. The combination of circulation and pigment particles is the picture commonly seen by my right eye. It has been less constantly seen by my left eye. With this eye the circulation, or very rarely the pigment, may form the whole picture. But when the pigment has been seen alone it has appeared under greater magnification than when it has been observed with the chorio-capillaris. The pigment granules then looked rod-like and were not regularly distributed over the visual field. Both pictures are very beautiful and very different. The one is a picture of still life—minute black rods variously and unsymmetrically arranged on a buff-coloured billowy surface; the other is a foliaceous pattern of a restless surging sea. The latter is by far the commoner picture. The pigment picture has been seen very rarely and could not be reproduced at will. Recent attempts to obtain it after a long break in the frequency of observations have not been successful, except as imperfect presentations in combination with pressure on the eyeball. Still more rarely patches of the pigment layer were observed as though not more than 12 of the foveal cones were

in action; and on two or possibly three occasions out of many hundreds of observations the pigment in one of the pigment cells appeared to be under very great magnification—at least 500 diameters. In these observations the pigment seemed distinctly crystalline, appearing very much like the haemin crystals prepared for forensic purposes as seen with an oil-immersion objective. It was only observed for one or two seconds and in that time no movement, Brownian or other, was noticed. Zehender, who saw something similar, observed slow movement. Migration of pigment particles is, of course, well known to occur in lower vertebrates (*cf.* Kühne); and Smith describes a swift, jerky motion of the pigment granules in the cytoplasm of cultures of the chick's eye which were much accelerated by continuous exposure to light. Movement of the pigment granules in mammals, however, is not known with certainty to occur.

Luminous Darting Points

The earliest and probably the most commonly observed entoptic phenomenon of the retinal group is a succession of luminous points, sometimes called glancing or dancing points, darting in more or less regular pathways over the visual field. They are easily seen by looking at any strongly lit surface such as a snow field, a blue or grey sky, a whitewashed wall or a sheet of white paper with relaxed accommodation. The mercury lamp directed against a white reflecting surface is an easy way of demonstrating them. Their origin has been much debated. Good accounts of recent opinions are given by Scheerer, Ebbecke and Adler, and of older observations by Helmholtz. They are unquestionably cells circulating in blood vessels; but what cells and what blood vessels it is difficult to determine. The points are commonly seen in the earlier part of an observation which it is hoped will end in viewing the chorio-capillaris. If care is taken they may be observed up to the point of transformation from the bright field to the dark field of the chorio-capillary circulation. The observation is difficult to make and is most easily made with a mercury lamp and a suitable reflector. With practice the luminous points for a time may be seen, although less brilliant than usual, at the periphery of the visual field and, indistinctly, the chorio-capillary circulation at the centre; and it may even be possible to see them momentarily as dark points as the chorio-capillaris becomes more visually resolved. But the luminous points are not in the chorio-capillary circulation. They are not seen when this circulation is resolved fully. Moreover, they are too small in size and in velocity to be situated there, and their flight does not correspond to the

flow of this circulation. Nor are they in the retinal circulation of the nerve layer. Their size and velocity are too great for this position and their course is not that of the retinal vessels. This fact can be easily shown by observing these luminous bodies against the reflected mercury light with one eye and producing the Purkyně figures by eccentric rotation of a pin-hole in a piece of black cardboard before the other eye. The two kinds of objects are seen to be on different planes, the luminous points appearing further away and giving the impression of being more highly magnified. The pathways in which the luminous points move cannot be made visible, but from the jerky movements of the points in what appears to be a network of channels it may be assumed with great probability that the cells are circulating in capillaries; and the experiment mentioned above where the luminous points and the retinal vessels are projected at the same time, with an apparent difference in magnification, suggests the deeper layer of capillaries in the inner nuclear layer as their place of origin. This is the place assigned to them for different, and to me insufficient, reasons by Zehender, Abelsdorff and Nagel, Bühler, Gescher and Fischer. If here the points must be caused by red blood corpuscles, refracting and under some conditions possibly reflecting light on to the layers of rods and cones. They are far too numerous to be white corpuscles in a circulation of this kind; and rarely they may be seen in groups of two or even three. Sometimes lines of light may be observed which are probably strings of corpuscles. It has been said that the red corpuscles being biconcave discs could not refract light rays on to the rods and cones, but this supposition ignores the positions which red corpuscles may assume in a capillary channel. Further, it is more difficult to explain physically the occurrence of these points, as dark points, if they are regarded as white than as red corpuscles. They may be seen as dark points against the sky, but the reversion is most easily effected by dark-adapting the eye or pressing on the eyeball and then gazing at the reflected mercury light. Usually the points are first seen as short dark lines, then as light points with a very short dark tail, and finally as the usual luminous points often with a short light tail. The tails, which have also been observed by others (*cf.* Thomsen), are probably of the nature of after-images.

Pressure Phosphenes

The fact that the retina can look backwards throws a new light on these occurrences, the chief factors in the production of which appear to be the pigment granules and the retro-retinal circulation. Thomsen says "there are as many pressure phenomena as folk

in the world" but, although variations in appearance even under apparently similar conditions are considerable, my own pressure phosphenes are fairly constant and, apart from some fantastic imagery in some of the descriptions in the literature, would appear to be not dissimilar from those of other observers. Only a few points bearing on the present investigation will be discussed. The simplest experiments are those made during the night after sleep by using uniform or increasing pressures over the eyeball in an antero-posterior direction. The phosphenes produced by heavy localized lateral pressure are more complex because among other things the retinal vessels can be seen in this way and even, as Vierordt showed, the retro-retinal circulation. The phosphenes obtained during daylight are influenced by the varying photopic state of the eye and are more easily obtained and more brilliant than those of the scotopic eye. The essential components of pressure phosphenes seem to be dark or light, sometimes coloured, patches, stationary or in motion; brilliant static or moving points of light recalling a spinthariscope effect; and, under certain degrees of pressure, regular geometrical figures such as hexagons, which may for a time cover the whole or greater part of the visual field, but may be interspersed and eventually replaced by the appearance of coloured dust (mostly bluish shades) on a dark background, similar to the appearance of a silver colloid solution as seen with a dark-ground condenser, except in the absence of Brownian movement of the particles. Fantasy figures such as the "Schneckenrechteck," the snakes and worms mentioned by Purkyně, do not appear to have been frequently observed. Czermak associates them with other geometrical formations (hexagons, etc.), while Thomsen attributes their appearance to the retinal blood vessels. If these figures are of circulatory origin they are probably out-of-focus effects of the chorio-capillary circulation variously interpreted psychologically.

Of these fundamental components of pressure phosphenes the static points and scintillating stars are probably due, directly or indirectly, to the pigment granules. The effect has been attributed to a pressure stimulation of the rods and cones by the pigment granules, but since the most brilliant appearances are obtained, not during pressure but, if this has been not too prolonged, immediately after its release, this explanation is improbable. Moreover, repeated successive pressure on the eyeball of a dark-adapted eye is associated with a diminution in the brilliance of these luminous points. It is more probable that the retinal pigment is a reservoir of energy (its function and properties need not for the present purpose be more clearly defined) which by the emission of electrons is capable of producing the appearance of light (*cf.* Schanz). Under normal conditions the energy being con-

stantly liberated is small and the particles being outside the posterior focus, if we may use that term, of the rods and foveal cones, the liberated energy is perceived only as a diffuse light of small intensity which may be the so-called self-light of the eye. But, when conditions are altered by pressure, a greater number of electrons may be emitted and this greater activity may manifest itself in more intense light points which, when brought into the approximate focus of the rods and cones by the continued pressure, are perceived as star-like lights. Adjustment of this condition to an optimum is more likely to occur after relaxation of pressure and this is the time when the brilliant stars are seen most clearly. Moreover, the greater activity caused by the pressure is likely to lead to temporary exhaustion which would explain the diminution and disappearance of these points of light with repeated pressures.

Another kind of light point may also be observed after discontinuing prolonged heavy pressure on the eyeball. These points, which are less luminous than the vibrating points, move rapidly across the visual field. They are best observed in the small dark patch corresponding to the area of the fovea. At one period during the return to normal the circulation of small discrete slightly luminous bodies, suggestive of blood corpuscles may be seen. Living blood corpuscles or any blood pigments have not, as far as I am aware, been credited with properties allied to chemi-luminescence; fluorescence, which appeared to be independent of the quality of the food, has been observed in the blood of certain parts of the silkworm during the spinning of the cocoon (Policard and Paillot) and A. and L. Gurwitsch and Sorin have stated that the circulating blood of the frog gives off mitogenetic rays; but their experiments—the exposure of the living tip of an onion rootlet to the anterior abdominal vein of a frog—do not carry conviction. It does not, however, seem to me impossible that the circulating blood in the capillaries of the exposed skin may absorb energy from the rays which penetrate to them and emit it as resonance radiation in fluorescence and that this energy in the blood of the choriocapillaris may be transformed in the retina into a form perceptible as light. Granular leucocytes show distinct fluorescence in ultra-violet light and the blood, like other tissues which act as protective agents to ultra-violet light, absorbs it and degrades it to visible light (Radley and Grant).

The dark patches and surrounding haloes have been explained by Thomsen as being due to the anaemia induced by the pressure with some associated environing hyperaemia; and apparently he believes that both choroidal and retinal vessels are involved. The

severest pressure that can be borne does not appear to influence materially the chorio-capillary circulation, but that the capillaries of the inner nuclear layer are to some extent readily influenced by pressure can be shown, if we accept them as the seat of the luminous points previously noticed, by observing the effect of pressure whilst gazing at the reflected mercury light. Even gentle pressure causes marked slowing of their movements, but complete cessation of movement is not readily obtained. But the retinal circulation can hardly be effective in inducing these colour patches since the circulation supplies the retina only to the inner nuclear layer and cessation of it, even if it occur, would scarcely act sufficiently rapidly on the conducting paths of the visual impulses to produce the effects experienced. Nor is it easy to understand how congestion, apart from hypothetical pressure, could induce haloes or other light effects of the nature of those seen in phosphenes. Also against these ideas is the fact that continued or deeper pressure can be adjusted to produce luminous patches where dark patches existed before. The most brilliant of these light patches are seen in the centre and correspond to the macular area. The centre of this area corresponding to the fovea may show, during increasing pressure, considerable brightness and even some evidence of an underlying circulation, but it more usually appears as an irregular dark patch with a bright surrounding halo corresponding to the outer thickened rim of the macula. This bright ring is probably caused by mechanical pressure on the nerve fibres coming from the fovea; but the matter has not been further investigated.

As already mentioned, Vierordt stated that the chorio-capillaris can be seen by deep pressure on the eyeball. Its visibility is perhaps most easily induced by pressure on the external canthus while the eye endeavours to look outwards, but in that case the retro-retinal circulation is confined to an arc or crescent at the antipodal area. The circulation is better seen, if it can be observed in this way, when the pressure is directed backwards but it is never so distinct as when resolved by the light of the microscope and the magnification under which it is seen is often considerably less, possibly because the plane of projection is nearer. Indications of the retro-retinal circulation are more easily obtained as a pressure effect than with condenser lighting and anyone prepared to take the risks and suffer the discomfort of prolonged pressure should be able to see it. The appearance is variable, as indeed it may be with all forms of observation, unless complete resolution is obtained. Not infrequently it presents a dark marbled appearance; at other times the small part of the circulation seen appears self-illuminated. After heavy pressure, well-defined, irregular brownish patches resembling in some degree chromatophore cells with a more distant

ill-defined rapid circulation may also be transiently observed. They are probably a view of a plane just anterior to the chorio-capillary circulation.

The most easily produced pressure phosphene is that induced by very gentle pressure on the external canthus when the eye is turned nasalwards. An antipodal dark patch with narrow surrounding halo is produced which does not overstep the shadow of the naso-orbital arch. This phosphene is more easily produced in light-adapted than in dark-adapted eyes and according to Klein it disappears on rubbing. According to him it takes longer and more vigorous rubbing to cause its disappearance in light-adapted than in dark-adapted eyes. From these experiments Klein concludes that the primary pressure effect cannot be behind the rods and cones, and he evolves a theory of vision by which he believes all pressure phosphenes are explained. It is, however, difficult to maintain uniformity of pressure in these experiments and in respect of disappearance of the halo my own observations do not confirm those of Klein. Klein assumes that only intermittent stimuli can excite sensory endings such as the rods and cones, and suggests that two or possibly more layers of the retina in front of the rods and cones are able to convert a constant stream of light rays into an intermittent stream (about 70 per second). In these layers exist unknown light-sensitive substances which undergo assimilation and dissimilation. The latter produces the self-light ("Eigenlicht") of the eye. When this intermittent light is equal in power to any external light falling on the retina, the visual mechanism cannot be affected since there is no change of stimulus, consequently there is a perception of blackness; if the two differ in power there is an intermittent stimulus falling on the rods and cones which is capable of transmission and brightness results. There are some difficulties in accepting the theory and the correlated explanations, but the question is too complex for brief discussion. Klein uses it to explain the luminous appearance of the larger retinal vessels which may often be induced by suitable, usually heavy pressure with rubbing on the eyeball, especially at the external canthus. He gives a characteristic figure (*Taf.*, Vol. IX, Fig. 3, 1910). If the effect is obtained the vessels may be observed as black cords (negative after-image) when the pressure ceases. The same luminous appearance of the retinal vessels may also be observed when the slit-lamp is moved from a sclerotic to a corneal position at a point about the sclero-corneal junction, an effect which is difficult to reconcile with Klein's views.

The geometrical forms seen entoptically, whether as pressure phosphenes or otherwise, have been discussed by Purkyně, Thomsen and others, but no satisfactory solution has been suggested. The hexagonal types observed during pressure cannot

be due to the retinal pigment cells for the hexagons of pressure phosphenes vary greatly in size, often diminishing as a perspective effect, and are not accompanied by visible pigment granules. In my own eyes they are commonly associated with irregular black patches dotted with coloured particles which with continued pressure may cover the whole field. Repeated pressure on the eyeball is also associated with diminution in intensity and final abolition of these geometric forms, a fact which points to the pigment granules as an important factor in their causation. These geometric forms observed during pressure arise from the regularity in structure of the rod and cone layer. The diameter of the foveal cones (2·5μ) is not many times that of a wavelength of light (0·6μ approximately), consequently the energy perceived as light given off, say by the pigment granules, may have a relatively wide angle and various geometric forms are possible. The diminution of these geometric forms on repetitions of pressure may be associated with the diminution in the luminosity ascribed to the pigment particles under similar conditions.

The appearance of coloured dust on a black ground is difficult to explain. The particles show no Brownian movement and it is, therefore, improbable that the appearance is due to a colloid structure highly magnified whilst their irregularity in size and position preclude these dots being regarded as a projected picture of planes of rods and cones.

Self-light of the Eye

The "chaos lumineaux" which is experienced when the eyes are closed and after-images have died away, has also not been satisfactorily explained. It is of two types:—(1) A uniform dark greyness which is experienced in the completely dark-adapted eye as seen after prolonged sleep; (2) luminous clouds, generally of a violet colour, moving in waves centripetally or centrifugally. The greyness which may be regarded as the fundamental self-light of the eye, has a uniform distribution and hence it is not surprising that the cause of it should have been sought for in the circulation. Thomsen believes that it arises from metabolic processes occurring in the blood circulating through the eye and points to the effect of CO_2 on the respiratory centre; but he brings forward no proof of such an action. Zehender, basing his views on Pfluger's metabolic work, believed that the self-light was produced by cell oxidations apparently of retro-retinal structures; whilst Klein, as already mentioned, apparently regards it as associated with the metabolism of light-sensitive substances in some of the retinal layers. For psychological purposes a central

action has been assumed (G. E. Müller), but without any supporting experimental evidence and with clinical evidence of questionable value. It is difficult to conceive of tone in a visual centre unless there is something to induce and maintain it, so that if a central origin of the self-light be assumed we are driven to accept the state of greyness as a rest state of the visual centres. Against this view is the fact that an almost infinitesimal amount of light —Joly thought that one electron might suffice to stimulate a cone— will produce in complete dark-adaptation a distinct sensation. Previously it has been suggested that the self-light might originate in the pigment granules of the retinal epithelium, and under pressure phosphenes it was stated that the retro-retinal circulation may show self-illumination. Two sources, therefore, seem available to explain the self-light of the eye. The energy required to produce the fundamental greyness of the intrinsic light must be extremely small and it is consequently difficult to devise observations or experiments which will decide between these two possible sources. The pigment granules seen with the chorio-capillary circulation are black and emit no light; but in my experience retro-retinal structures, except as a pressure effect, are only seen in an environment of light more intense than that necessary to produce self-light. Let us consider the other form of the intrinsic light of the eye, namely, the moving violet clouds which by some are also regarded as fundamental to the self-light. The clouds are more noticeable on attention and they show a deeper violet hue when observed after exposure to bright daylight than when observed in the darkness of the night after prolonged sleep. The variation in hue of the clouds with increasing dark-adaptation seems to be very similar to that observed in passing from the middle violet of the spectrum to the ultra-violet with a spectrophotometer. If we attribute the self-light to some property of the retinal pigment allied to chemi-luminescence this difference might be explained by the cumulative effect of light during the day upon the pigment granules; but it is less easy to explain the rapid wave motion of these violet clouds, which is usually a characteristic feature, by the assumption that they are produced by the pigment granules. Sometimes these violet clouds may be seen in the field of the microscope when this is lit during a bright day from a window. With difficulty the chorio-capillary circulation and the retinal pigment may be seen at the same time, although indistinctly. The violet clouds then seem to be over the circulation, their contours seem to follow those of the circulation and their velocity appears to be similar to that of the circulation. The circulation, in fact, seems to be directing the movements of the clouds. But since the clouds when observed appear to be constantly changing form and position and to be in a plane anterior to the circulation they

cannot be merely a presentation of light in the circulation. Some other factors must be involved. W. Marshall believes that physiological fatigue plays a part. Santonin, when it causes xanthopsia increases these violet clouds in the eye. Its action, apparently one primarily upon violet perception, is probably retinal in origin and due to the transformation of santonin to some other substance (W. Marshall). One of his experiments is of fundamental importance to the present discussion. A subject had his eyes completely protected from light for 40 minutes; an injection of 10 mgm. santonin in solution was then given into the median basilic vein, the time taken by the injection being 45 seconds. "About 20 seconds after the commencement of the injection, that is, while it was still in progress, the subject remarked that the violet clouds were increasing rapidly in intensity and 10 seconds later exclaimed that he saw a brilliant violet field traversed by numerous brilliant moving stars. From this period the violet diminished in brilliance and was less marked when the injection terminated. The diminution in intensity continued and two minutes after the beginning of the injection was manifest merely as a glow. The stars were still seen, but they also soon faded away." A control experiment in which the same dose was given while the eyes were kept open produced practically no symptoms. The two points in this experiment bearing on the present enquiry are the transient flare up of light in eyes completely in the dark and the temporary brilliance of the luminous points. They show that in the absence of any light entering the eyes the appearance of light may be produced through the circulation. For the second symptom W. Marshall suggests "a temporary self-luminescence of the blood corpuscles induced by santonin" a result which "could only be attained by an interaction with some constituent ejecting sufficient electrons to produce luminescence. Such an interaction might also explain the brilliant violet light seen in the dark-adapted eye." Zehender saw luminous points in the dark, but he believed that the pigment emitted sufficient light to make these points visible. I have observed luminous points in comparative darkness, as after closing the eyes in dim twilight, but have not been able to determine whether they were identical with the darting luminous points previously considered. The most conclusive evidence that the retro-retinal circulation is able to produce the perception of light is found in Vierordt's experiment already mentioned, namely, that by proper pressure on the eyeball parts of the chorio-capillaris, usually over a small area only, appear luminous. From these observations it is difficult to avoid the conclusion that the retro-retinal circulation plays some part in the production of the self-light in the eye however it may be produced.

At this point reference may be made to the visual purple, since it has been said to be visible entoptically and thus might be a factor in the causation of self-light. The references cited are Tait, Boll, Ewald and Edridge-Green. Tait's "Note on a Singular Property of the Retina" is based on the observation that on awakening during the night a not very bright gas jet with a ground glass shade seemed to be surrounded for a second or two by dark crimson. He got skilful in reproducing this effect but it only occurred at the instant of awakening. He thought that probably the retina, or nerve cells with it, sleeps and on awakening portions connected with the lowest of primary forms of colour are first to come into action. Ewald first suggested that this appearance might be due to the visual purple; and, in view of the wide acceptance of his idea it is desirable to summarize his experiments. He observed on opening his eyes after awakening in the morning a black vessel figure (Purkyně's figure) on the ceiling which with practice he learned to observe with greater clearness; and eventually he saw yellow flecks in the neighbourhood of the fixation point which disappeared in less than two seconds. Wishing to examine this appearance with greater exactitude he asked his servant to throw a thick black cloth over his head before he awoke and after gaining full consciousness his eyes were covered by closely applying his hands and the cloth was removed. Directing his gaze to the ceiling his hands were removed quickly and replaced. He saw the two larger vessels which festoon above and below the macula and also a darkish yellow patch in the centre which he thought was the macula. The yellow patch was surrounded by a rose-coloured halo shading off almost to white at the blind spot and the festoon of vessels and having a diameter corresponding to about 5 mm. on the retina. The appearance is shown in a coloured figure (Fig. 9). It disappeared before the yellow patch and was only observed in a completely rested eye. No trace of it was seen after an hour's rest in a dark room during the day. The appearance corresponded so well with that of a central part of a freshly extirpated human retina still containing the visual purple that he thought the rose-coloured surround must be an entoptic appearance of the visual purple, although he mentions that Kühne found no rose-coloured appearance in mammalian eyes carefully removed in sodium light. He discusses the possibility that the colour might be due to the blood in the retinal or choroidal vessels, but rejects the idea that it is caused by the retinal vessels since the larger vessels appear black owing to their thickness while the colour produced by blood in the capillaries would be reddish-yellow and not rose-red as observed. And he rejects a choroidal origin because the effect is seen only in a rested eye, with presumably completely regenerated visual

purple, capable of being affected by such weak stimuli. Two comments on Ewald's observations are offered:—(1) The rose-coloured patch is not limited to the environment of the macula, but may be seen in the position of the macula itself where visual purple is believed to be almost absent. This appearance I have seen on awakening during the night and switching on an 8-watt electric light with parchment shade about a foot from the eyes while the eyelids were still closed. (2) Since the visual purple probably originates in the retinal pigment and does not extend in front of the rods and cones it would seem that if it can be observed entoptically it must be seen by the extra-macular rods and cones looking backwards while the yellow pigment of the macula is perceived by the foveal cones looking forwards, a Janus effect of adjoining similar units which it is difficult to conceive. Visual purple is not confined to the immediate neighbourhood of the macula and Ewald explains the limited field of the rose-coloured patch to the diminished sensitivity of the peripheral retina for red, a limitation which does not seem to agree with Boll's observation quoted by Ewald in support of his views. Boll (p. 20) noticed that the ophthalmoscopic picture of the retina is more intensely red when seen immediately after an individual awakens in a dark room in the morning than it appears during the day. Several factors may be involved in the explanation of this difference, but it is not probable that an almost imperceptible layer of visual purple can be perceived in the relatively intense red of the retinal field.

Edridge-Green's evidence for the entoptic visibility of the visual purple is of a somewhat different kind. He observed, in a not too bright room, whirling currents when the eye was partially covered. He concludes that these currents cannot be due to vessels because the centre of the retina, where the greatest movement is seen, is free from vessels and he interprets the phenomenon as currents of visual purple flowing into the external fovea. As the chorio-capillaris adjacent to the fovea has been seen by at least three people independently, Edridge-Green's objection does not seem to be valid; and, having observed this circulation in its many unresolved forms I have no doubt whatever that the figure (Fig. 5) given in his paper to illustrate these currents is an out-of-focus appearance of the retro-retinal circulation. The main objection to Edridge-Green's explanation is the fact that these whirling currents illustrated, indistinct though they be, are visions of form; and it is difficult to understand how a picture of form can be produced by a circulation of visual purple even if we assume, in Edridge-Green's sense, that it occurs. A consideration of the function of the visual purple as a photo-sensitiser and its part in photo-electric theory brings other difficulties which it is

unnecessary to discuss. The same remarks are applicable to Barrett's reference to visual purple, which appears to have been overlooked by other writers, and is quoted later as another example of an out-of-focus presentation of the retro-retinal circulation.

The Seat of Vision for Form

Arey says (p. 775) "the exact level of the image in the retina and by assumption the level where the transformation from light energy to nervous excitation takes place is not surely known." The parallactic experiments of H. Müller (1855) with Purkyně's figure showed that it occurs in the pigment epithelium or between it and the outer nuclear layer. Much controversy has followed since, but the position has not been more clearly defined; and within recent years different investigators have assigned to it the three possible positions, namely, the inner segment of the rods and cones, the outer segment of the rods and cones, and the pigment layer of the retina. Lindsay Johnson thought that the image was formed behind the retina on the brilliant surface of the tapetum or the fusca pigment layer of the choroid and was then reflected back on to the bacillary layer; and Zoth concludes that there is a primary energy transformation in the pigment epithelium and a secondary energy transformation in the rods and cones presumably in the outer segments. Hess would seem to place the transformation in the outer and Arey in the inner segments.

The visibility of the chorio-capillaris and the retinal pigment should allow us to state the seat of energy transformation resulting in vision more accurately than heretofore. Since the retinal pigment can be viewed entoptically the seat of the transformation of energy cannot be in the retinal pigment layer. Whether it is in the inner or outer segment of the rods and cones is more difficult to decide. If we could be certain of the magnification and position of any two structures, one in front and one behind the seat of energy transformation, the riddle might be solved. But these criteria are not readily ascertained, especially as regards the magnification under which structures in front of the rods and cones are seen. The chorio-capillaris projected in the field of the microscope at approximately 10 inches distance, is observed entoptically under a magnification of about 100 diameters. This figure was obtained as a result of observing a section of the human retina under the microscope and adjusting the magnification so that the size of the retinal pigment is the same as that of the pigment seen entoptically when the slide is moved out of the field. The same method when applied to structures in front of the rods and cones gives

a larger experimental error which makes a comparison of questionable value. The capillaries viewed entoptically are the surface capillaries of the retina and are seen under too small a magnification for their diameter to be gauged. And, mainly owing to their luminosity, it is not easy to estimate the size of the luminous points which, for reasons already advanced, have been placed in the capillaries of the inner nuclear layer. They are said by Ebbecke to appear 2 mm. in diameter at a projected distance of 25 cm. My own observations make them not more than 1 mm. at two metres distance. It is thus obvious that the angular size of these points as estimated by comparison with external objects is liable to great variation. A note from Dr. H. Moore says "An obstacle on the retina of size 7·5μ would produce a black spot having an angular size of 1/2,000 radians or appearing as large as a spot 1 mm. in diameter when viewed at a distance of two metres." If this estimate of 1 mm. size at two metres distance is correct it suggests that these darting points are caused by blood corpuscles.

The visibility alone of retro-retinal structures seems to afford a more reliable guide to the position of the transformation although offering difficulties of its own. Little stress can be laid on the fact that the chorio-capillary circulation may appear under somewhat different magnification by different methods of observation since this matter is capable of more than one explanation, but if it is permissible to use those accidental and rare observations of pigment granules under high magnification when the eye is practised to observed retro-retinal structures the question is simpler. Zehender estimated the granules he saw as 2 mm. in length. The crystals seen on two occasions by me appeared to be at least 1 mm. long projected to 10 inches distance. Measurement of the fuscin crystals on my own slides of the human retina gave an average length of 2μ* so that the magnification under which the crystals were seen entoptically was at least $\times$ 500. This magnification places the plane of energy transformation in the outer segment of the foveal cones. But apart from the magnification under which it may be observed it appears to me that the mere visibility of the chorio-capillaris supports the view that energy transformation occurs in the outer segment. The fibrous body between the inner and outer segments of the rods and cones must have some function. Its form as usually figured suggests that it may have some condensing action on the light rays proceeding from the surface of the retina to the outer segment and if it

* Arey (p. 748) gives the length of fuscin crystals as 1μ–5μ but it is doubtful if the latter length is ever reached in man. My own measurements of definitely discrete crystals gave much narrower limits, namely, 1·5μ to 2·5μ. Longer measurements are probably due to two or more crystals in alignment which is not uncommon and is often difficult to recognise.

possesses this function it would tend to prevent the formation of an image proceeding from the back of the eye on the inner segment. Therefore it seems probable that the outer segment is the seat of the transformation of light energy to nervous excitation; and it is also probable that the transformation occurs throughout a considerable depth, perhaps throughout the whole of the outer segment, so that any plane may be a percipient part; otherwise it would be difficult to explain some of the observations recorded in this paper or the perception of chiaroscuro. Moreover, there seems to be an appreciation of depth in viewing the retro-retinal circulation, partly perhaps due to the magnification under which it is seen, which is difficult to understand unless perception is possible through some thickness of the rods and cones.

Comments

The literature of entoptic phenomena, even of that dealing with the problems under discussion, is voluminous. It is not intended to criticise it. Nearly all of it has been written from the point of view that the human eye can only function in an inverted form and that the only circulatory phenomena perceptible are those likely to be associated with the retinal vessels. And yet these vessels can be observed entoptically, except as pressure phosphenes, no more than momentarily unless they are in constant movement relative to the light source. It is, however, evident from the literature that most investigators have dimly perceived out-of-focus presentations of the chorio-capillary circulation without recognizing the significance of their observations. A quotation from Barrett's paper (p. 129) will serve as an example: "After the eye has been in complete darkness for some time a curious entoptic phenomenon can be seen when a lighted candle is held near the eye. Numerous streams and patches of what seems to be a light flocculent matter will be seen quickly moving on a dark purple background which covers the field of vision. The appearance somewhat resembles a very brisk agitation and settling of curds in a purple whey. In the course of half a minute or less the moving flocculent streams clear off and the retina assumes its normal state. The experiment is best made after waking up in the night and immediately after lighting a bedside candle. It is possible that the phenomenon, which does not appear to be mentioned by any writer on physiological optics, may be connected with the presence of the visual purple in the retina." The last point has been dealt with previously. The streams and brisk agitation can only be appreciated by one who has seen the retro-retinal circulation. Three investigators have ascribed the circulation seen to the chorio-capillaris. Vierordt (1856) first observed it as

a pressure phosphene and with rapid intermittent illumination, but later he saw it in the dark without any artificial aid. The matter was investigated further by his pupil Laiblin (1858) whose thesis, referred to by Vierordt and by Zehender, I have been unable to obtain. Zehender (1895), like myself, was looking for entoptic effects which could be seen without distorting the eye. He describes the occurrence of scintillating points seen with closed eyes on awakening in the morning and later he observed the retro-retinal circulation in this way. He says one does not see this blood circulation when in complete darkness, but one sees it with very little light from outside as, for example, through closed eyelids.

Vierordt offers no explanation of the phenomenon. How the appearance of circulating blood corpuscles produced by pressure on the eyeball without the mediation of objective light is possible is, he says, one of the great riddles of the physiology of vision. Zehender explained the sensation of points of light as possibly due to the blood corpuscles in the layer adjacent to the rods and cones exerting sufficient pressure on these to produce the sensation of light—he calls them microscopic phosphenes. As he could not conceive of the retro-retinal circulation being seen without some illumination he concluded that the illumination was provided by the self-light of the eye which he attributed to cell combustion, although he apparently thought that chemical changes associated with the pigment granules also play a part. He says (p. 350): "It appears that physiology permits the assumption that the 'explosions' in animal cells which develop CO_2 are accompanied not only by local rises of temperature but also by the production of light. And hence it may be that such explosions in the retro-retinal cells are accompanied by the development of light. There is thus within the eye a constant light source—a burning torch—which enables retro-retinal things to be seen; and the objection that the blood circulation in the chorio-capillaris cannot be seen because it is in the dark behind the pigment layer is removed." And later (p. 379): "If we may assume as probable light and phosphorescence as occurring in the retro-retinal region, then we are able to explain other visual perceptions. If there is sufficient light and brightness at the back of the eye to see the capillaries and the choroid then there must be sufficient to perceive in great magnification the pigment epithelial layer between the retina and the choroid. Under favourable conditions the fuscin particles in the pigment cells and the movement in them could be clearly seen." On one occasion he appears to have seen a small clump of pigment break up into three rod-like particles although he saw no light changes occur with it. I have not been able from casual observation to see the chorio-capillary circulation by

Vierordt's method of intermittent illumination, but have frequently obtained it as a pressure phosphene. Recent criticism, particularly by Scheerer and Ebbecke, has thrown doubt on Vierordt and Zehender's observations. Ebbecke says (p. 247): "That notwithstanding numerous endeavours their observations still remain unconfirmed," and later (p. 265): "One finds no sufficient criteria for the entoptic perception of structures of the choroid or of the pigment epithelium." Anyone who has properly seen these structures can be in no possible doubt on the point. Whether, as Scheerer seems to suggest, the ability to see retro-retinal structures is limited to elderly people—Zehender was 75, I was 63, but Vierordt was only 38 years of age when observations were made—is a matter for further investigation. A more important question is how are these structures seen? Most of my own observations were made before looking into the literature of the subject and they led me to conceptions which apparently have not yet been expressed. Reason has been given for regarding the outer segment of the rods and foveal cones as the seat of energy transformation for visual form. If this be accepted we have to explain how the outer segment is able to see retro-retinal things. In all probability the rods and foveal cones have slightly rounded ends, and most planes of the outer segment and not any particular one are capable of visual perception. Apparently the end of the outer segment comes into approximate focus with the things seen, and since even the lowest magnification, that is the vision of the most distal object, the chorio-capillaris, is roughly $\times 100$, it follows that the ends of the outer segments must come almost into apposition with the retro-retinal structures observed. When the pigment of the retinal epithelium is seen under higher magnification the apposition must be still closer. This adjustment of the outer segment is possibly controlled by the contraction and relaxation of the myoid of the inner segment. If this point is allowed there seems to be little difficulty in explaining the various phenomena. The contraction of the myoid in animals in which it has been observed appears, however, to have been leisurely; in man it must be assumed to be rapid, or at least to be capable of great rapidity. Garten suggests that it may occur too rapidly in man for fixation.

Evidence in support of a state of relaxation in the layer of rods and cones may be obtained from visual observations made immediately on awakening from sleep in a dark room. The retinal pigment may usually be seen under these conditions. The most successful plan in my own case has been to turn the face with the eyelids, still closed, towards an electric globe a metre or so above the bed and switching the light on. There appears at first a haze of light sometimes with indefinite starry points at the

periphery followed in about a second by a field of fine pigment granules often associated with a geometrical pattern lasting one or two seconds and being replaced by another haze of light. The effect can be seen with open eyes if sufficient bedclothes be pulled over the face to reduce the intensity of light to the small value required. If the eye is not completely dark-adapted by sleep the pigment granules are not seen, but under certain conditions a honeycomb or maculated pattern may be indistinctly observed or an out-of-focus picture of imbricated circles or a punctate or other effect. If the light is turned off before the retinal pigment picture has faded away violet dots irregularly scattered over the central field and occupying about two-fifths of the visible area may be seen. The dots are probably projected presentations of the rods and foveal cones. The surround is usually indefinite, but very rarely an hexagonal form was observed similar to the surface projections figured by Max Schultze (*Taf.*, Vol. XIII, Fig. 2) and others as that outside the area of the fovea. The appearance may be explained by the ordinary cones with short outer segments being unable to look backwards owing to their inability to focus retro-retinal structures of distinct contour because they are unable to extend sufficiently far back or because of their conical form. The ability to look backwards is probably limited to the rods and foveal cones and is much more noticeable in the latter than in the former, in part because they control the central area of the retro-retinal field, which apparently is the seat of acutest perception in retro-retinal as in normal vision, and possibly in part because of their great length which confers on them greater depth for visual perception and greater power of movement. For experiments of this nature complete dark-adaptation is necessary and this completeness can only be obtained by sleep in a dark room.

These and other observations suggested that during sleep the myoid of the inner segment relaxes and allows the outer segment of the rods and foveal cones to come into closer relation with neuro-retinal structures. On awakening, if the proper small intensity of light, as through closed eyelids, falls on the retina, the pigment is seen for a second or two probably as the myoid, contracting under the stimulus of the light rays, causes the outer segment to come into suitable position to receive the image of the pigment granules on one or more of its percipient planes. Further contraction which continues even with this small intensity of light causes the pigment granules to become out-of-focus and to be no longer seen. The effect can be observed only within narrow limits of a small intensity of light. So far it has not been possible to arrange a light intensity small enough to keep the pigment granules in focus for any length of time. Very rarely a fuscin crystal has momentarily been observed highly magnified in this way,

and on one occasion I saw what seemed to be fuscin crystals gradually replaced by granules as though one were focusing a camera from an anterior layer of crystals to a posterior layer of granules before the latter finally disappeared. This phenomenon seems explicable only on the assumption that something was contracting and withdrawing the end of the foveal cone from the pigment layers. As stated previously, Zehender noticed movement when he saw the pigment granules highly magnified, but I was not so fortunate.

The question arises how retro-retinal structures are sufficiently lit to be seen by the outer segment of the foveal cones. Since the chorio-capillaris can be observed, in part at least, apparently self-illuminated by deep pressure on the eyeball the simplest explanation of the light source necessary to view the retro-retinal circulation is the self-light of the circulation itself; but in all Zehender's and my own observations, except the experiments on pressure phosphenes, the lighting has been from without. It would thus seem as if the retro-retinal circulation is seen by transmitted and reflected light combined. Light rays from outside appear to be totally reflected in the rods and cones (H. Müller, p. 101; Garten, p. 99; see, however, Klein, 1911). Probably a large proportion of the rays pass through the retina and lighting up the pigment layer and adjoining chorio-capillaris allow them to be observed in the same way as a vertical illuminator allows one to light and observe an opaque surface with the microscope. This process would best explain the way in which the chorio-capillary circulation is seen by the microscope lighting or opal glass lighting described. In these observations some relaxation of the myoid or other structure involved is necessary to bring the outer segment into proper position for observation; and it seems probable that the reason why the chorio-capillaris has not been observed more frequently may be the inability of most people to obtain this necessary relaxation, while the ability to produce it may be greater in age than in youth. This essential relaxation is accompanied by a feeling of slight strain and is not merely the sensation of rest from relaxed accommodation. The relaxation of the myoid, or whatever the process which is involved may be in this class of observation, is capable of training. This result has been noticed by most experimenters. After considerable practice I am able to see the retro-retinal circulation whenever I put my eyes to a microscope and I have become able to see it against almost any uniform white or grey surface. On the other hand after ceasing observations for some time retro-retinal pictures, especially the pigment ones, are more difficult to obtain.

But what becomes of the light rays that are still falling on the retina after the change from a bright visual field to one that

has been compared to dark-ground? The effect is probably akin to that in which an object on a bright field when intently gazed at with fixed eyes disappears and the field is replaced by one of a dim grey. This result is usually attributed to fatigue, but that cannot be the explanation in retro-retinal observations nor can the loss of light be explained by scattering. Can it be that the extension of the outer segments allows the light rays to pass through the rods and foveal cones and become almost wholly absorbed by the retinal pigment and choroidal circulations and in the process light up these retro-retinal structures more effectively? To whatever the transition from light to dark-ground effect may be due it is comparable in some measure with the change from photopic to scotopic vision. The perception of retro-retinal structures only occurs in light of low intensity.

It is not proposed to discuss the bearing on the theories of vision of the fact that the retina can look backwards, but its relation to the duplicity theory may be referred to since this theory does not seem to be applicable when the retina looks backwards. Vision in this direction has been compared with scotopic vision and it is well performed by the foveal cones. It is difficult to explain the anomaly that the fovea is night blind in normal vision and very sensitive to small intensities of light when looking backwards. Is the fibrous body of importance here also?

Much more might be added on entoptic phenomena associated with the retina. The effects obtained by intermittent illumination which have been productive of many interesting observations (Czermak, Exner, Charpentier, Nuel, Edridge-Green, and others) have not been considered and no mention has been made of the "blue arcs" or of the effects which may be observed with polarized light, mainly because the investigation was primarily concerned with the ability of the rods and foveal cones to look backwards. This faculty of the rods and cones seems to explain much that is otherwise obscure in the literature. The causes of many if not all entoptic phenomena not hitherto understood are probably to be found in the normal structures of the eye. Appearances which are common to different individuals must have an objective basis; and all structures which theoretically we might expect to see may be observed under conditions which can be reproduced or which may occur through chance observations not repeatable at will. For most persons who are unable to relax sufficiently, the structures merely form a basis for shadowy or out-of-focus presentations which nevertheless may be explained from our knowledge of these structures and the behaviour of light rays in the retina. The shimmering which may often be seen on awakening in the morning against any flat structure, such as the ceiling, reflecting the proper low intensity of light for the

purpose, is certainly produced by the retinal pigment and the chorio-capillary circulation. It is interesting to watch it wax with the increasing light of the dawn and diminish as the light grows stronger, although it still may be seen for a period in the shadows of the room. Entoptic phenomena which are not common to individuals may be due to pathological changes or to subjective effects. Of the latter probably every grade may occur up to a complete eidetic state; but with memory pictures and other similar conceptions entoptic phenomena are not primarily concerned.

Summary

The rods and foveal cones can look backwards and observe the retinal pigment and chorio-capillary circulation.

On rare and chance occasions the retinal pigment may be seen under different and high magnifications.

The difficulties of observation and different appearances are attributed to varying positions of the outer segment, possibly caused by greater or less relaxation of the myoid of the inner segment, of the rods and cones.

The outer segment is regarded as the seat of transformation of light energy to nervous excitation.

The darting luminous points are attributed to red blood corpuscles in the capillaries of the inner nuclear layer.

The self-light of the eye is probably associated with energy emanating from the pigment particles of the retina and from the retro-retinal circulation.

Most unexplained entoptic appearances associated with the retina, except those which may be due to or influenced by the mentality, especially the powers of pictorial conception, of the individual, are explained as out-of-focus presentations of normal structures in or adjoining the retina.

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ORBITAL TERATOMA

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ORBITAL teratomata are very rare tumours, and in ophthalmic literature I am only able to find 12 cases which so far have been reported. They are congenital, grow very rapidly, the child as a rule dying in the first few weeks of life. They may also occur in the form of a cystic tumour. The tumour consists of the derivatives of two or three germinal layers.

The Marchand-Bonnet theory best explains the formation of these tumours. During the early development of the embryo, the blastomere severed from its connections may remain as a

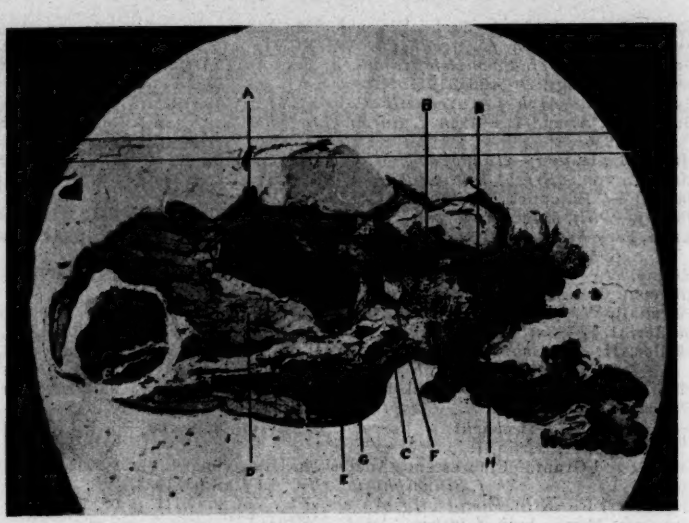

FIG. 1.

A low power micro-photograph taken with the micro-planar lens. Magnification ×4. A, cartilage; B, intestinal epithelium; C, bone; D, fat; E, connective tissue bands with some smooth muscle; F, blood vessel; G, neuroglial tissue; H, smooth muscle and connective tissue.

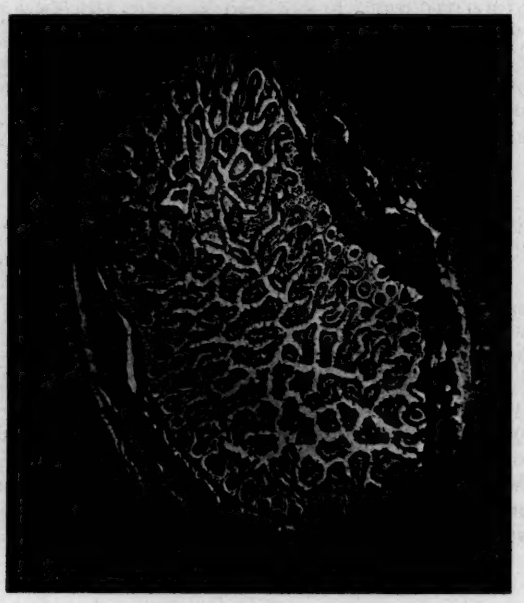

FIG. 2*a*.

resting germ in any part of the body and begins to grow later or develop at the same time as the normal organs. As blastomeres are still capable of producing a normal body, after the first segmentation, but are able to produce only a few parts on continued division, it can be understood that derivatives of all or of only some embryonic layers are present in these tumours according as it is near the first cleavage or distant from it. The earlier the segmentation occurs, the less frequently does the germ stay latent.

Mizuo divides orbital tumours into four groups according to their degree of development.

(1) A foetus or a teratoid foetus attached to the orbit by an umbilical cord (orbitopagus parasiticus)—Mizuo's case.

(2) Parts of the body of a second foetus hang from the orbit (Ahlfeld's case).

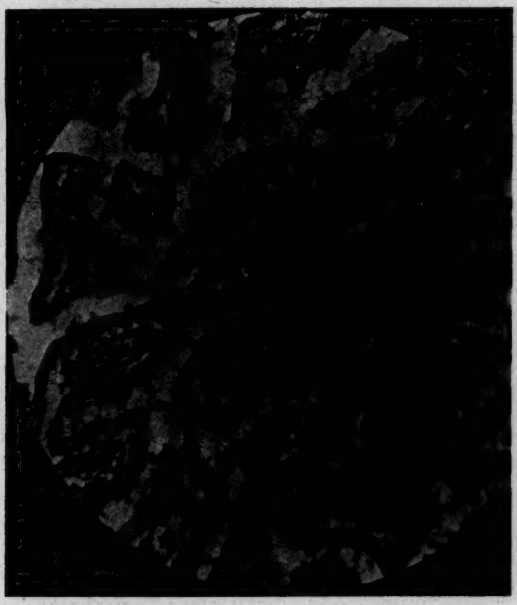

FIG. 2*b*.

Micro-photograph showing epithelial glandular structure resembling intestinal epithelium. In some of the cells, round or oval white globules are seen which appear to be secretion showing that the cells are actually functioning. (*a*) shows the whole area; (*b*) part of the same under a higher magnification.

(3) A shapeless mass growing from the orbit and found anatomically to be a teratoma (Broer and Weigert's, Courant's and von Hippel's cases).

(4) The congenital orbital tumour containing the products of two germinal layers (cysts, cartilage, etc., mixed tumour). Mixed tumours of the lacrymal gland come under this heading.

FIG. 3.

Micro-photograph showing the area of smooth muscle and connective tissue.

Teratoma sometimes contains parts of organs and portions of the body. von Hippel states that complete organs are never found in these tumours.

True intra-orbital teratomata occur in infants, consist of derivatives of all three germinal layers and are very uncommon. The case to be described presently is the second to be reported from

India—the first was described by Elliot and Ingraham in 1910. In chronological order the following cases have been recorded:—

Holmes in 1863; Broer and Weigert, 1876; Ahlfeld, 1880; Lawson, 1884; Courant, 1893; Ewetsky in 1904; von Hippel in 1906; Mizuo in 1908; Coulter and Coats, 1910; Elliot and Ingraham, 1910; Corbett, 1925; Kearney, 1926.

In Holmes' case the tumour consisted of a female twin and was seen seven weeks after birth. The eye was protruded and formed the apex of the tumour.

In Broer and Weigert's case, the baby was seen one day after birth when the tumour was found. The eyeball was on the apex of the tumour, the cornea was opaque and the tumour was in the right orbit and displaced the nose and cheek. The tumour was the size of an apple and was excised. The child died.

In Ahlfeld's case the tumour consisted of a separate foetus. The buttock and the left leg projected from the left orbit.

In Lawson's case, the baby was seen two days after birth. The eyeball was situated on the top of the tumour and the cornea was cloudy. The child died.

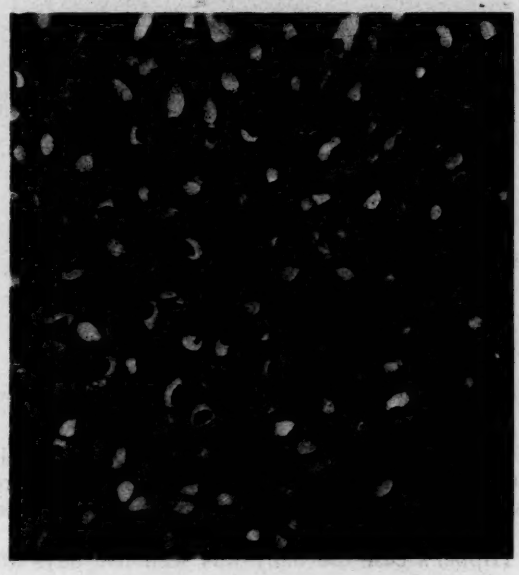

FIG. 4.

Micro-photograph showing a rather primitive form of cartilage which formed a large encapsuled mass in the tumour.

In Courant's case the baby was seen immediately after birth. The eyeball was completely protruded and situated on the top of the tumour about the size of an apple. The cornea was opaque. The tumour was removed and the child recovered.

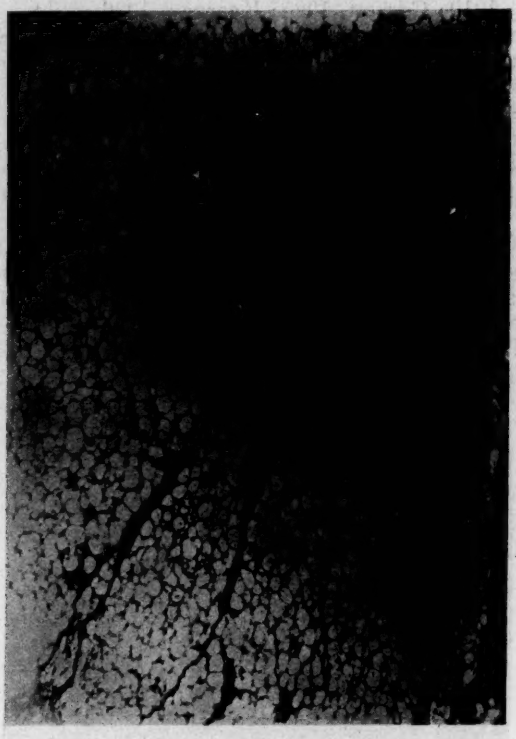

FIG. 5.

A micro-photograph showing fatty tissue intersected with connective tissue bands containing blood vessels.

In Ewetsky's case, the child was seen four and a half months after birth. The tumour filled the right orbit and surrounded a rudimentary eye at its summit. The tumour was removed, but the child died.

In von Hippel's case the baby was seen five days after birth. The tumour was the size of a moderate apple, enclosed the eyeball and the optic nerve. The cornea was dull. The tumour was removed.

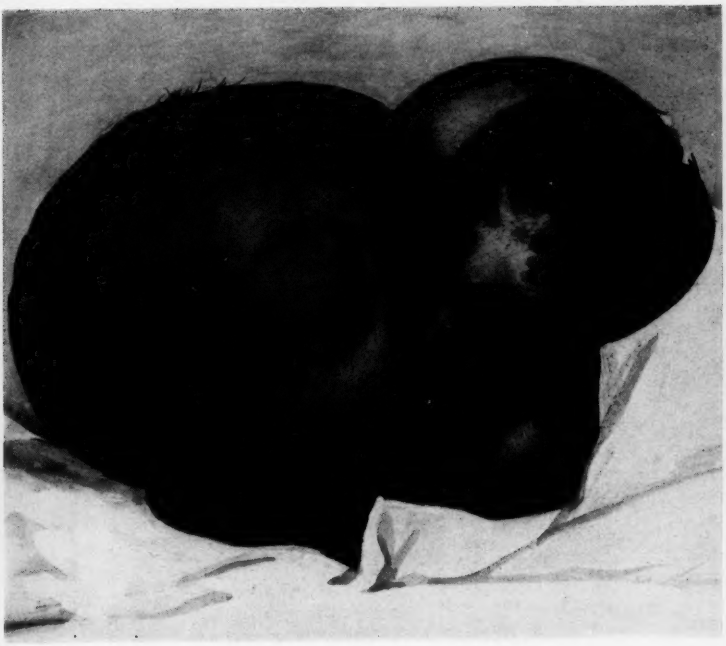

PLATE I.

Teratoma of the orbit. Condition at birth.

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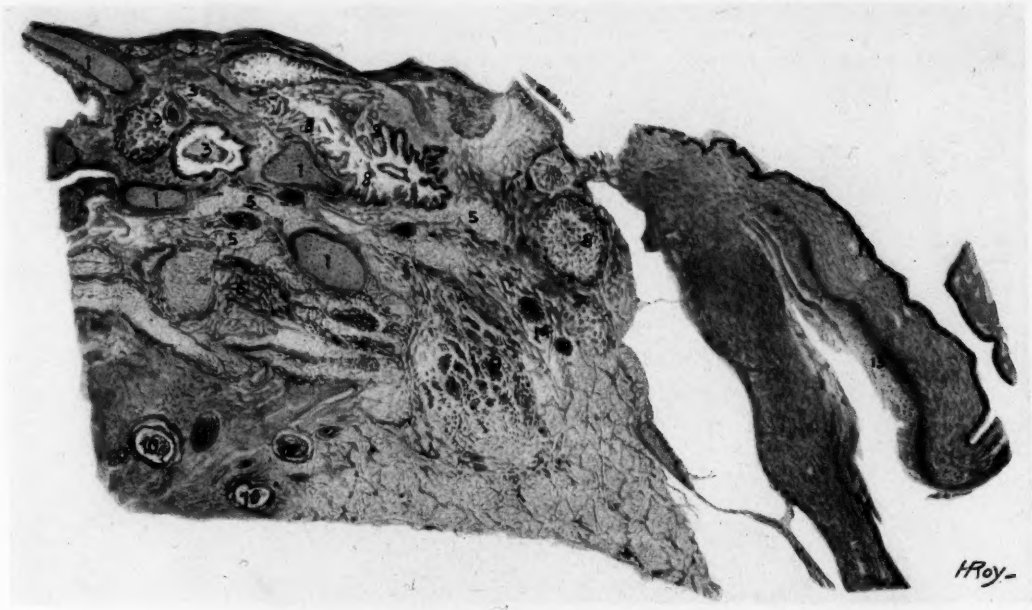

PLATE II.

A coloured drawing of the section showing fourteen different types of tissue. Magnification ×8.

1. Cartilage.
2. Nerve.
3. Probably small intestine.
4. Lymphoid tissue.
5. Fat.
6. Muscle (involuntary),
7. Post. root ganglion.
8. Intestinal wall c̄ villi.
9. Heart muscle.
10. Hair follicles cystic (sweat glands?)
11. Liver tissue.
12. Squamous epithelium (skin).
13. Vascular tissue c̄ melanoblasts (choroid).
14. Parathyroid.

In Mizuo's case, a Japanese child was seen immediately after birth. A red injected swelling of the conjunctiva was seen which grew quickly and projected beyond the eyelids. On the 50th day after birth, a small teratoid foetus and the opening in the conjunctiva grew larger and the whole foetus was expelled with rudimentary arms and legs. The child lived and some vision was retained in the left eye.

In Coulter and Coats' case, seen three days after birth, the left eye was pushed forwards outside the orbit with the eyelid stretched

FIG. 6.

A micro-photograph showing commencing bone formation from cartilage.

around its equator. The cornea was opaque and a soft elastic tumour could be felt in the orbit. The child lived 19 days and died of exhaustion.

In Elliot and Ingraham's case, a Hindu female child was seen six months after birth. A tumour about the size of a small lime was present at birth and was then the size of an orange. The left eye was not to be seen. The nose, cheek and mouth were pushed to the right side. The tumour was removed and the child lived.

In Kearney's case a female child was seen immediately after birth, the right eye was pushed forward by a red mass about the size and shape of a tomato of medium size. The cornea was the same as that of the other eye and was not opaque, both pupils were equal in size. The tumour was removed and the child lived.

The following case of intra-orbital teratoma recently came under my care :—

R. S., Bengali, female baby, first child, born at full term on August 9, 1932, quite normal. Both father and mother were in good health. The baby was brought to the hospital one week after birth, and the case was diagnosed as an intra-orbital new growth. The baby was up to normal size and weighed seven pounds. From the left orbital cavity a red mass about the size of an ordinary tomato protruded and in the middle of the mass

FIG. 7.

A micro-photograph showing a "wild riot" of fibrous tissue bundles passing in all directions.

the anterior half of the eye could be seen, the posterior half being buried in the growth. The cornea was irregularly opaque rendering the examination of the fundus impossible. The tension of the eyeball was normal. The size of the cornea appeared to be about the same as in the normal eye. The upper and lower eyelids were tremendously distended. The mass was growing principally on the inner side of the orbital cavity and was pressing upon the lateral side of the nose obliterating the left nasal cavity. The

FIG. 8.

growth was hard and elastic, and the consistence was the same all over.

An exenteration of the orbit was carried out on August 16, 1932, a week after birth. The tumour was found to be adherent to the eyeball, but was separated by blunt dissection. After removal the mass was incised and found to contain a cyst holding about half an ounce of serous-like fluid. The rest consisted of solid growth about the size of a large walnut. The operation was carried out very rapidly and the baby had an uneventful recovery. The case was last seen by me on April 13, 1934, and a picture of the child is shown in the accompanying figure (Fig. 8). The palpebral fissure and the eyelids are now the same as in the right eye. There is only a small conjunctival sac. The vertical and the horizontal meridia of the bony orbit are somewhat larger than in the right eye. In other respects the child is quite normal.

Pathological report.—Serial sections show all the different tvpes of tissues to be found in the body which originate in the three

germinal layers, namely, cartilage, nerve, lymphoid tissue, fat, involuntary and heart muscle, skin, hair follicles, vascular tissue with melanoblasts, small intestine, liver, and parathyroid. The eyeball and the optic nerve are normal and are independent of the origin of the tumour.

Diagnosis.—True filial teratoma of the left orbit.

In this case certain cells of the developing embryo had taken on independent growth after being segregated in the left orbit and this must have taken place relatively late in intra-uterine life as the development of the eye and optic nerve had already taken place.

I am indebted to Lt.-Col. H. Shortt, I.M.S., Director of the Central Research Institute, India, for the micro-photographs, and to Capt. S. K. Roy, Surgeon to the Mayo Hospital, Calcutta, for bringing the case to me.

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POSTERIOR LENTICONUS (REPORT OF A CASE)*

BY

T. H. LUO, M.D.

CHINA

AMONG its congenital or developmental anomalies, the human crystalline lens may present a conical bulging either on its anterior or posterior surface. The anomaly is a rare ocular condition, and according to the literature, the posterior type, lenticonus posterior, is more common than the anterior variety, lenticonus anterior. Posterior lenticonus was first recognized and reported by Meyer[1] in 1888. Owing to mistakes in either diagnosis or classification

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many of the cases reported in the early days have been regarded with suspicion and placed in the group of so-called "false lenticonus." It is only with the use of the slit-lamp that cases of "false lenticonus" can be unmasked. Tyson[2] in 1928 reduced the number of "true" cases reported to "about six." Since then, according to Marsh[3], over 20 slit-lamp studies have been reported under this title though some of the slit-lamp diagnoses are not without suspicion.

In our clinic, most of the patients with pupillary opacities or impairment of vision which cannot be improved by manifest refraction are examined under a cycloplegic with the retinoscope or ophthalmoscope or slit-lamp or all three instruments. This seems sufficient safeguard against any escape of posterior lenticonus if it does occur. Still, the following case is the only one seen in this hospital.

Patient, a Chinese boy, aged 13 years, was brought to our eye clinic in August, 1934, for blurring of vision of both eyes for distance of about three years' duration. His eyes were apparently normal until about three years before, when (at the age of 10 years) he started to go to school and was discovered by his teachers to be short-sighted. Last year, his father, becoming very curious about his eyes, looked at them carefully and found some opacities in both pupillary areas. In the past the patient had had no ocular disease or injuries, no convulsions or serious general diseases. The patient's mother had similar lens opacities for which she came to the Peiping Union Medical College at the same time. Her eye condition was diagnosed to be congenital cataract complicated by a "cataract in osteomalacia." The mother's father and one of her sisters were also said to have been affected with lens opacities since childhood. As far as the parents could tell, the rest of the family members and relatives, except for near-sightedness, had no similar eye conditions.

General examination of the boy in our medical department revealed essentially normal physical findings. No congenital abnormalities could be found in other parts of the body. Blood calcium and phosphorus were within normal limits.

On ocular examination, the lids, conjunctiva, cornea, anterior chamber, iris and pupil were normal. In both pupillary areas there were greyish-white opacities, more extensive and dense in the left one, which appeared to the naked eye and loupe to be located in the posterior part of the lens. Vision of the right eye was 6/20; of the left eye 6/30, and could not be improved with lenses or pin-hole disc. Both eyes read Jaeger No. 1 at about 6 cms.

When the eyes were examined under homatropine dilatation the following findings were obtained. The left pupillary area showed a

fairly big, central, roundish, dark greyish-blue opacity which gave no parallactic displacement on movement of the retinoscope. The opacity was surrounded by a narrow, peripheral clear zone which gave a red reflex. Retinoscopy of this eye was not possible. In the centre of the right pupil was a small dense opacity. The red reflex was fairly bright, but owing to irregular movements of the shadow retinoscopy was difficult. The lens that seemed to come closest to a "full correction" was −3·0 D. sph. −1·0 D. cyl. axis 75° which did not improve the vision. The so-called "oil-drop phenomenon" was not present.

Fundi of both eyes were normal as seen through the periphery of the pupil. Tactile tension normal.

Under the slit-lamp, the real nature of the ocular condition came into view. The posterior surface of the left lens protruded unduly into the vitreous (Fig. 1). This protrusion was cup-shaped, the diameter of the cup being about three-fourths of the diameter of the lens and its depth being about one antero-posterior diameter of the lens proper. Its edge, the junction of the normal and abnormal posterior surface, was rounded off gradually like that of a basin. The walls of the conus were densely opaque, the opacity consisted grossly of two layers which were of a greyish-white, irregularly punctate appearance. From between the two edges opaque, radiating processes came out which reached almost the equator of the lens. With the narrow beam, the formation of the conus seemed to start from the posterior peripheral band of the embryonic nucleus and the opacities involved this band and what was behind it. Owing to the density of the opacities, nothing could be seen through them. The lens substance within the conus was clear except for some isolated opaque stipplings near its walls. The rest of the lens was also clear. The anterior and posterior "Y" sutures were, however, not visible. In the right lens there was an irregular-shaped opacity at the posterior pole of the embryonic nucleus (Fig. 2). The opacity was densest in the centre with a small and irregularly shallow depression on its anterior surface and gradually faded off toward the periphery (posterior polar cataract). The lens substance anterior and posterior to this region was clear. The "ring reflex" of Vogt and the "scissors reflex" of Marsh could not be demonstrated.

Discussion

What is a true posterior lenticonus? A comprehensive satisfactory definition is wanting. Collins and Mayou[4] described posterior lenticonus as a protrusion backward of the lens substance through a gap in the capsule into the vitreous, or, if the capsule is only abnormally thin and not actually deficient, a bulging

FIG. 1.

Posterior Lenticonus, left eye.

FIG. 2.

Posterior Polar Cataract, right eye.

UNIV OF MICH

backward of the lens substance at the posterior pole. According to Colombo's definition[5], a veritable posterior lenticonus requires the following characteristics: "A congenital lesion, without anterior lens changes connected with the conus, and absence of any tissue changes pointing to diseases or trauma . . . . a transparent, hemispherical, sharply-outlined prominence on the posterior pole." Marsh[6], who recently brought the literature on this subject up to date, remarked that the former definition was indefinite and incomprehensive, while the latter, though the most exact one, was too specific and rigid. By comparing the reported cases, he offered a system of classification in which he divided the cases into four groups. Class I is Colombo's type form, a transparent hemispherical bulge set "like a skull cap" on the posterior pole of an otherwise normal lens. To Class II belong those cases which are otherwise typical, but show opacity at the bottom of the conus or irregularity in their form. Class III includes cases with a good lenticonus, but with related opacities or other changes in the lens substance. The uncertain, doubtful cases are put into Class IV. Besides these, he collected a small group of cases which are not veritable lenticonus, but might be confused with it and called these "quasi-lenticonus." If his classification is generally accepted, many definite cases of posterior lenticonus will not be excluded just because of having incidental or perhaps secondary changes.

The chief symptom which brings a patient with posterior lenticonus to an eye physician is the impairment or blurring of vision. Before the days of the slit-lamp the diagnostic signs were the so-called "oil-drop phenomenon" surrounded by a variable shadow, and the greatly increased myopia of the central part as compared with the periphery when the eyes were examined with the retinoscope or ophthalmoscope. Gullstrand[7] in his study of the movement of the Purkinje images of the posterior lens surface demonstrated another valuable sign, *i.e.*, the movement of the reflections on the posterior surface for determining the form and changes in its curvature. With the slit-lamp not only is the conus definitely seen, but its form and dimensions can be measured. The "ring reflex" of Vogt[8] has been considered a slit-lamp sign of the first importance and is probably expected to be present in every typical form of posterior lenticonus. Marsh,[9] in 1927, observed another slit-lamp phenomenon, "the scissors reflex," by using the narrow beam and also described the application of the dot beam, both of which, according to him, had not been mentioned by previous writers.

The origin of this unusual anomaly is unknown. Various speculative theories have been advanced, but not satisfactorily proved. These, Marsh has discussed extensively in his paper,

and he also proposed a new theory of "accommodative strain" to account for the condition. A repetition of the same is therefore omitted here. The fact that in our case several members of the family have been affected with lens opacities since childhood, speaks for the conditions being a congenital anomaly. So far no clinically observed case has given opportunity for microscopical study and cases which have been microscopically studied have not been recognized during life.

In our case, without the aid of the slit-lamp, the condition could easily have passed for a posterior polar or cortical cataract, because the appearance to the naked eye was just that of a dense opacity situated in the deep parts of the lens and besides, the ophthalmoscopic "oil-drop phenomenon" was absent and a difference in refraction between the central part and the periphery could not be detected. The slit-lamp, however, very clearly revealed the presence of a posterior cone-shaped projection. In cases in which the opacities are especially pronounced, a lenticonus which is not very obvious is very difficult to diagnose, even with the aid of the slit-lamp. Reese's statement[10] that "the greater the opacity, the more one is inclined to doubt the authenticity of the case," characterizes the situation very well. From the description of Butler's report[11] the present case, except for details, is essentially similar to his fourth one. Bothman's case[12], though only briefly reported, seems also to be of the same type. Both these cases are placed by Marsh in his IVth class of posterior lenticonus. If Marsh's classification is to be adopted, the present case, being unmistakably a true posterior lenticonus, could be listed only under his class III, although the opacities may appear not quite comparable with his description.

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HYALINE BODIES ON THE DISCS

BY

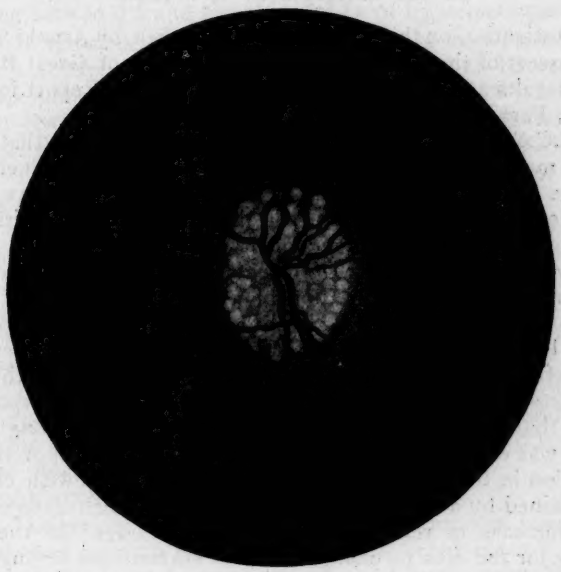
F. C. PLUMMER

LIVERPOOL

THIS painting is of the discs of a boy, aged 10 years, referred by his school for defective vision.

R. vision with +2·5 D. sph. = 6/6 partly } both eyes together
L. vision with +2·5 D. sph. = 6/6 partly } = 6/6 fully.

The visual fields were slightly but regularly contracted. Five months later no further change was to be seen. Both discs showed,



to an equal extent, marked hyaline bodies, which overlapped the margins.

The picture does not show up in sufficient relief the small "sago-grain-like" appearance of the hyaline bodies.

The boy is healthy and the third in a family of five and except for a severe attack of scarlet fever at six years old, there is nothing of importance in his history.

There is nothing in the family history and no record of any

ocular disease. The other members of the family that were examined showed no changes in the fundi.

This case was shown at the North of England Ophthalmological Society but no member had seen a similar case before and this is my excuse for submitting this drawing for publication.

The most exhaustive account in the literature seems to be in Vol. II, pp. 661 *et seq.* of Parsons, Pathology of the Eye.

ANNOTATION

The Normal Refraction in Infancy and its bearing on the development of Myopia

An investigation on this subject was undertaken, by Arnold Sorsby, at the request of the Jewish Health Organization of Great Britain; and the results are presented in the L.C.C. Annual Report for 1933 (Vol. IV, Part III, p. 55) just published.

The L.C.C. has repeatedly drawn attention to the fact that visual defect is much more frequent in Jewish than in non-Jewish children at the age of 14 years when pupils leave school. Defective vision among Jews is also heavier on the boys than on the girls, the reverse of what occurs among non-Jewish children.

Sorsby's previous attempt "to disentangle the factors of race, sex and environment in the causation of a heavier incidence of visual defect in Jewish children" was published in our columns (Vol. XII, p. 197, 1928). His results confirmed the greater prevalence of visual defect in Jewish boys; but did not substantiate the view that excessive close-work done by Jewish boys was responsible. He held that the "greater prevalence of visual defect among Jewish children was due to a racial variation, while the reversal of the sex-distribution in the incidence of refractive error in Jewish children was explained by a sex-linked non-racial factor which determines a greater increase of refraction in the case of boys; in them the tendency for the eyes to change towards emmetropia or myopia is therefore greater, and with more Jewish boys having a low hypermetropic reserve, the greater incidence of myopia among Jewish children at the school-leaving age could be thus explained."

This paper dealt with selected material.

Miss McIlroy, investigating for the L.C.C. (Annual Report for 1928, Vol. III, p. 86), could not substantiate the presence of a lower hypermetropic reserve in Jewish children; she also found that low myopia, absent at the age of seven years, increases during school life in all groups, but to a far greater extent among Jewish children, both boys and girls, than among gentile children. Her

results were based on a large series, but are open to the criticism that the refractions were not done under cycloplegia, and that thereby "much latent hypermetropia must have been missed."

The present investigation by Sorsby was carried out at the Council's infant schools. Complete atropine cycloplegia was obtained. 1,344 infants, 772 Jewish and 672 non-Jewish between the ages of four and eight years were examined. At this age it may be assumed that no excessive amount of close-work was done in the infants' schools. The report is illustrated by a graph and by tables.

This valuable paper may be summarised in the author's own words as follows:—

1. Under atropine cycloplegia about 75 per cent. of the infant population between the ages of four and eight years show a refraction ranging betwen 0·5 and less than 3·5 D. of hypermetropia.

2. In the same age group 9·1 per cent. of non-Jewish children show a refraction around +0·5 D. (with ±0·75 D. range); the corresponding percentage for Jewish children is 12·7; 2·4 per cent. of non-Jewish children as against 4·8 per cent. of Jewish children show a refraction around −0·5 D. (with a range of −0·75 D.).

3. There is no sex difference in the distribution of refractive errors during infancy.

4. Astigmatism is decidedly more frequent in Jewish children. Considered in three divisions: (1) 0·75 and 1·0 D., (2) 1·25 to 2·0 D., and (3) 2·25 D. and over, the percentages for Jews and non-Jews are 15·7, 10·6, 4·7, and 10·7, 7·3 and 2·0 respectively. The total incidence of astigmatism is therefore 31 and 20 per cent. for Jewish and non-Jewish infants respectively.

5. The refraction curve of infants between the ages of four and eight years does not follow a binomial curve. In addition, the curve for Jewish children is more spread out and tilted towards the myopic side.

Sorsby's conclusions are as follow:—

1. The greater prevalence of low hypermetropia in Jewish infants is confirmed from an examination of unselected cases. It is held that to this and not to any environmental factor must be ascribed the greater frequency of myopia amongst Jewish children at the school-leaving age.

2. The higher incidence of visual defect in Jewish children is to be explained not only by the onset of myopia in a larger group of potential myopes but also by the greater frequency of astigmatism.

3. The greater incidence of astigmatism in Jews is perhaps to be explained along biological lines. Astigmatism is frequently inherited in a recessive manner, and would be more frequent in such a highly inbred people as the Jews.

ABSTRACTS

I.—PATHOLOGY

(1) **Rand, Wheeler (Los Angeles).—Glioma of the retina.** *Arch. of Ophthal.*, June, 1934.

(1) The term "Glioma of the Retina" probably includes several different types of growth and **Rand** quotes Grinhu's classification which is as follows:—(1) Medullo-epitheliomata arising from the cells of the primitive neural tube. These tumours are rare and consist of various types of cells, primarily medullary epithelial, but also retino-blastomatic and spongioblastic and exhibiting rosettes; (2) retino-blastomata, whose cells are bipotential and may form ganglion cells or adult glia. These form the majority of retinal 'gliomata.' They extend into the orbit, invade the base of the brain and show distant metastases; (3) neuro-epitheliomata, composed for the most part of primitive spongioblasts, arranged in true rosettes. They are less malignant than the retino-blastomata. That glioma retinae is a highly malignant tumour is well-known and Reese found, on examining the cut end of the nerve in 119 excised eyes, that gliomatous tissue was present in 43 per cent. The rational treatment of such cases is intracranial removal of the optic nerve. This was performed in a case described by Rand, but unfortunately the patient was not seen until four months after enucleation of the eye, and the tumour had already invaded the chiasma and base of the brain. The author suggests that before an eye is removed for glioma retinae, the optic foramen should be examined by X-rays. If it shows signs of enlargement, this would constitute an indication for intracranial section of the optic nerve. He also advocates the microscopic examination of the cut end of the nerve in every case of enucleation for glioma retinae and the performance of the intracranial operation if extension of growth has occurred.

F. A. W-N.

(2) **Davies, Windsor S. (Ann Arbor, Michigan).—Neoplasms of the lacrimal gland.** *Arch. of Ophthal.*, July, 1934.

(2) Before proceeding to describe two cases of his own, **Davies** gives an interesting review of this condition. The majority of the tumours are of the mixed variety. Warthin, in 1901, suggested that they arose from the endothelium of the lymph spaces, but Verhoeff, in 1904, regarded them as congenital epithelial tumours,

a view which is upheld by Birch-Hirschfeld and later investigators. The neoplasm develops slowly and most commonly affects patients after middle age, but may occur in the young when it is usually rapidly fatal. The first sign is proptosis and there may be some early pain. Disturbances of vision and of ocular movement are later manifestations. It is quite possible for the tumour to grow to a considerable size before it can be felt. Eversion of the upper lid is, of course, a help in diagnosis.

This should be made as early as possible, because quite a number of cases are fatal—12·5 per cent. in a recent review of 95 cases—and complete removal is essential. This may necessitate performance of a Krönlein operation, though smaller tumours can be reached by an incision over the upper lateral orbital margin. Post-operative irradiation is advisable if the tumour is not encapsuled. The author's two cases were dealt with by Krönlein's operation, the first was a true mixed tumour, but the second was an adeno-carcinoma.

F. A. W-N.

II.—GLAUCOMA

(1) **Kirwan, E. W. O.'G. (Calcutta).—Primary glaucoma.** *Arch. of Ophthal.*, July, 1934.

(1) Epidemic dropsy is a disease probably due to a spore-forming proteolytic bacillus which grows in diseased rice. It produces a toxin resembling histamine which causes a cardio-capillary crisis. One attack does not confer immunity, but rather, predisposes to relapse in subsequent epidemics owing to the patient's becoming hypersensitive to the toxin. The general features of the disease comprise oedema with discolouration of the skin, sometimes diarrhoea, and tachycardia with breathlessness and enlargement of the heart. Telangiectatic dilatation of the capillaries is the most interesting pathological feature. **Kirwan** finds that glaucoma is usually a late manifestation, but in some epidemics it may be the most conspicuous symptom. It is most commonly seen in persons between the ages of 20 and 35 years, but is not unknown at as early as eight years. Pain is usually absent, the first symptom being haloes and defective vision. The anterior chamber is never shallow, the pupil is normal in appearance and the cornea is steamy or not according to the height of the intra-ocular pressure. The media and lenses are normal and cupping is not present except in cases of long standing. The tension is rarely below 50 mm. Hg (Schiötz) and figures of 70-100 mm. Hg are quite

common. The field changes are characteristic of glaucoma, the nasal quadrants being always more affected than the temporal and Seidel's and Bjerrum's scotomata appearing late in the disease when presumably cupping has developed. With regard to pathogenesis, there seems little doubt that the histamine-like toxin had caused increased permeability of the capillary endothelium of the ciliary body allowing increased outflow of aqueous and so a rise of intra-ocular pressure. The glaucoma responded well to corneo-scleral trephining.

F. A. W-N.

(2) **Juler, Frank (London).—Prognosis in primary glaucoma.** *Lancet*, December 15, 1934.

(2) So much has been written during recent years on glaucoma from every aspect that it hardly seems necessary to make an abstract of the article by **Juler**, contributed to the *Lancet* by invitation, and, therefore, intended more especially for the general practitioner. One passage only need be quoted because it points to a difference of opinion. "The chronic simple glaucoma without more than a suspicion of tension is controlled by miotic drugs for a time, and in some cases for many years. In such cases one will watch the fields of vision and will only advise operation when they are becoming diminished in area. In my experience such cases do well with operation, but I know that all ophthalmic surgeons do not agree with me on that point."

ERNEST THOMSON.

(3) **Böck, J. Kronfeld, Peter C., and Stough, J. T. (Chicago).—Effect on intra-ocular tension of corneal massage with the tonometer of Schiötz.** *Arch. of Ophthal.*, May, 1934.

(3) This work was performed by **Böck, Kronfeld and Stough** in order to determine whether the reaction of the human eye to pressure on the cornea was sufficiently constant and characteristic to serve as an aid in the diagnosis of glaucoma. The method employed was to use a Schiötz tonometer fitted with a 15 gramme weight and to allow it to rest on the patient's cornea for two minutes, the tension being measured at the beginning and end of the procedure. A decrease of tension varying from 5 to 15 mm. Hg occurred in every normal eye, the greatest decreases occurring in those eyes with the highest tension. The decrease does not depend on the depth of the impression of the cornea by the foot of the tonometer since this was necessarily greater in the eyes with lower tension. The age of the patient appeared to have no effect on the result obtained. In glaucomatous eyes (only those with a tension of 36 mm. Hg or under were tested) it was found that if the

original tension were below 27 mm. Hg, behaviour tended to be the same as in normal eyes. If the tension were above 27 mm. Hg, the drop of tension was considerably less than in the non-glaucomatous eye.

F. A. W-N.

(4) **Cohen, M., Newell, J. M. and Killian, J. A. (New York).—Experimental studies on swelling of the vitreous gel and on intra-ocular pressure.** *Arch. of Ophthal.*, September, 1934.

(4) **Cohen, Newell and Killian** engaged on this work in order to find out whether swelling of the vitreous—which is sometimes regarded as a cause of simple glaucoma—could really occur. Their first experiments consisted in placing ox vitreous into the mouth of a thistle funnel the wide end of which was sealed with a porous alundum disc. Immersion of the funnel into solutions of acids, alkalies, and of sodium thiocyanate produced no alteration in the size of the vitreous gel. A second series of experiments showed that immersion of the vitreous in alkaline solutions had no demonstrable effect on the bound or the free fluid of the vitreous. When acid was used, some variation did occur, but it was inconsistent, and the same occurred with various salts. In filtration experiments, it was found that a large amount of the fluid in the vitreous was "unbound" and the authors, therefore, agree with those who state that it is not a homogeneous colloid, but is composed of two phases, *i.e.*, fibres or membranes suspended in a liquid which can flow slowly in or out of the mass. It is thus impossible for the vitreous to swell, because if the fibres enlarged the increase in size could be at once compensated by escape of some of the free liquid. There remains the possibility of osmotic changes in the blood bringing about swelling of the vitreous. A series of 10 rats were fed on a diet which has been shown experimentally to lower the proportion of serum proteins by 40 per cent. Seven of the rats survived for 19 weeks, and of them, five had marked accumulations of ascitic fluid. In none of them was there any evidence of increased intra-ocular pressure.

F. A. W-N.

(5) **Nelander, B. (Upsala).—The frequency of glaucoma in the general population. (Ueber die Haufigkeit des Primärglaukoms in der Gesamtbevölkerung).** *Acta Ophthal.*, Vol. XI, p. 370, 1933.

(5) **Nelander** reviews the literature on glaucoma as a cause of blindness and on the frequency of the disease amongst patients seen in eye hospitals. In European countries glaucoma accounts for 10-20 per cent. of cases of blindness, whilst about 1 per cent.

of eye patients come for this complaint. On a careful analysis of cases seen in Upsala (a Swedish university town with a population of 30,000), the author concludes that the incidence for primary glaucoma is 3 per 1,000, whilst new cases amount to 0·23 per 1,000 per annum. Glaucoma is rare under 50 years of age, whilst at 90 years of age the danger of glaucoma rises to 6 per cent.; women are rather more prone than men.

ARNOLD SORSBY.

III.—LENS

(1) **Kugelberg, I. (Upsala).—Juvenile cataract in the dermatoses. Cataracta syndermatotica. (Juvenile Katarakt bei Dermatosen. Cataracta syndermatotica).** *Klin. Monatsbl. f. Augenheilk.*, Vol. XCII, p. 484, 1934.

(1) In an exhaustive survey on the literature on cataract in skin affections, **Kugelberg** shows that endocrine disturbances are frequent in sclerodermia, but on the available evidence it cannot be stated definitely that both the skin affection and the lens changes are determined by these disturbances. A familial factor seems to be present. He records two cases of cataract in neurodermatitis; these cases were familial and the lesion was confined to the anterior cortex, the nuclear and perinuclear regions of the lens being spared. Reverting to the difficulty of determining cause and effect as between the skin and lens lesions, he suggests the name of cataracta syndermatotica as opposed to the more current name of cataracta dermatogenes.

ARNOLD SORSBY.

(2) **Caramazza. (Bologna).—The vitreous after cataract extraction. (Biomicroscopia del vitreo nell'afachia).** *Boll. d'Ocul.*, September, 1934.

(2) **Caramazza** has examined the condition of the vitreous in a number of patients who have undergone cataract operation, with a view of finding whether the nature of the operation has any effect on the condition of the vitreous.

There may be found alteration of the structure of the vitreous such for example, as increased fluidity, synchisis scintillans, which is probably to a large extent independent of the operation; or of its amount and relation to other parts, which depend on the injury done during operation. The author has rarely found blood in the vitreous in any quantity; and only when the hyaloid has been ruptured with hernia of the vitreous. In these cases the blood

is often very slow in absorbing. He finds that hernia of the vitreous is more common after intra- than after extra-capsular extraction. The size of the hernia varies with the size of the pupil (being larger when there has been iridectomy), and with the condition of the vitreous. When the vitreous is herniated, it frequently may be seen to adhere to the scar. After simple intra-capsular extraction, the hernia of the vitreous often pushes the base of the iris forward, and this becomes adherent to the scar. He concludes that the method of election for cataract operation is the extra-capsular with or without iridectomy according to circumstances, provided that a sufficiently large part of the anterior capsule be removed.

HAROLD GRIMSDALE.

(3) **Yanes, T. R. (Havana).—Ocular tension in cases of cataract extraction. (La tension ocular en las extracciones de cataratas).** *Revista Cubana de Oto.-Neuro. Oftal.*, Vol. CXI, p. 7, 1934.

(3) **Yanes** stresses the importance of taking the ocular tension with a tonometer before every cataract extraction and of continuing to do so until the patient is discharged.

He quotes Ferrer, who always insists that the tension shall be taken as a routine in all cases for operation. He takes as normal any tension lying between 22 and 40 millimetres of mercury. When the tension is a low normal, on opening the anterior chamber the lens does not come forward spontaneously and manoeuvres for its expulsion can be performed without danger of vitreous loss. When the tension is low, atropine must be used, and with a simple extraction there is no danger of iris prolapse. In those cases in which the tension, though normal, is on the high side, as soon as the cornea is incised the iris bulges forward, and there is a tendency for the lens to be expelled spontaneously, and here there is more danger of vitreous loss. Combined extraction should be performed in these cases.

When the tension is above or below the normal limits, then something must be done before the operation to guard against accidents. When the tension is lower than normal, it must be raised, and the operation should only be performed when it is above 20 mm. Hg. In order to do this, atropine must be used for a time varying from days to (rarely) weeks before the operation. Normal eyes show variations in tension. In eyes of low tension iridectomy is unnecessary and atropine must be applied immediately after the operation and during convalescence.

It is in the early days following the operation that there is cause for anxiety, and during these days the tension cannot be

taken by any means. If the hypotension has been treated, sometimes atropine is not used after the operation for fear of hypertension. In those cases in which the tension shows no variation, and is always low, *i.e.*, below 20 mm. Hg, atropine must be used. On the other hand, atropine should never be used in post-operation cases where the tension has previously been high. In those cases in which the tension is above 40 mm., eserine or pilocarpine should be used as a preliminary, and if the high tension still persists, a preliminary iridectomy should be performed.

If it is thought advisable to perform only one operation, the combined method should be used. Atropine should not be used after the operation.

Intra-capsular extraction is easier and less risky in eyes with low tension, but in these cases it is not so beneficial as in those with a previously high tension, because it is the remaining capsule and cortex that tend to increase the intra-ocular tension.

The author thinks that tonometry is of extraordinary importance in cataract cases. He attributes the accidents he has seen, even in cases operated upon by experienced surgeons, to a lack of study of this point. However skilful they may be, operating upon an eye with a high tension, even within normal limits, gives rise to unavoidable dangers.

E. E. CASS.

IV.—RETINAL DETACHMENT

(1) **Vogt, Alfred (Zürich).—Results of cathode electrolysis (catholysis), a new method of treating retinal detachment. (Erfolge der Kathodenelectrolyse ["Katholyse"], einer neuen Methode zur Heilung der Netzhautablösung).** *Arch. f. Ophthal.*, Vol. CXXXIII, p. 26.

(1) The new method of treating detached retina with electrolysis through the cathode, which is here described, is claimed by **Vogt** to be less damaging to the tissues, more simple (any apparatus for the removal of cilia suffices if the needles are fine) and more successful than any other method yet put forward to combat this disease.

Cathode electrolysis produces fine gas bubbles along the track of the needle through the tissues to the surface of the detached retina; hence catholysis offers this great advantage that one can observe with the ophthalmoscope the point of entry of the needle by this formation of gas or foam on the retina at the time of operation, and thereby obtain guidance as to its position in relation

to the hole in the retina and its repeated application in the region required, *viz.*, round the edges and in the floor of the hole or holes.

He emphasizes the importance of keeping the cornea clear for ophthalmoscopic examination; for this purpose he uses only a subconjunctival injection of novocaine and adrenalin as anaesthetic over the area to be attacked, and avoids any loss of time in performing the operation.

By this method, in which a current of only 0·5-1 milliampère is momentarily applied at each point of insertion of the needle, he claims that the adhesions of the conjunctiva and orbital tissues to the sclerotic are not so dense as with other operations (and hence it can be repeated more easily), the reaction in the retina and choroid produces far less extensive scarring, and the escape of vitreous is minimal. The danger of muscle paresis is also avoided, as it is only exceptionally necessary to resect a muscle. The resection of half the tendon is all that may be required, or the muscle may be drawn to one side; indeed, the tendon or muscle itself can be pierced with the needle if necessary.

Extreme old age or long duration of the detachment appears to be no contraindication to this operation.

THOMAS SNOWBALL.

(2) **Szily, A. von and Machemer, H. (Münster).—Experimental study of bipolar superficial electrolysis in the treatment of retinal detachment. (Experimentalle Untersuchungen ueber die zweipolige "Oberflächenelektrolyse" als Methode zur Behandlung der Netzhautablösung).** *Klin. Monatsbl. f. Augenheilk.*, Vol. XCII, p. 44, 1934.

(2) **v. Szily and Machemer** cauterized small areas of sclerotic by means of two platinum electrodes close to each other; a current of 2 to 20 milliampères was used for 10 seconds, inducing a discolouration of the sclera. They hold that the procedure is devoid of danger and that the chemical changes induced are helpful. Anatomical preparations illustrate this paper and on the results obtained in animals the method was adopted clinically "for the past half year, to some extent with encouraging results."

ARNOLD SORSBY.

(3) **Pavia.—Method of localising and treating detachment of the retina with tears near the posterior pole of the eye. (Desprendimiento de retina. Procedimiento para localizar y tratar desgarros del polo posterior).** *Revista Oto.-Neuro. Oftal. Sud.-Americana*, 1934.

(3) To localize these holes, **Pavia** suggests that their position should be referred to the optic disc as well as to the macula; thus, a hole may lie at "10 o'clock" from the disc and "6 o'clock"

from the macula. In treating the hole, he applies a curved glass conductor, which is passed so that its end abuts against the sheath of the nerve, while the shaft lies in the line of the hole as related to the disc; the convex side of the conductor is grooved, and at some distance from the end the groove terminates in a perforation. There are a series of conductors with perforations at varying distances from the end. The appropriate one is selected. Down the groove the electrode is passed until its point engages in and emerges through the hole into contact with the sclerotic at the estimated place. The current is then turned on. To calculate the distance which separate these ruptures from the limbus, the author suggests that we should subtract the distance of the rupture from the macula, from the total limbo-macular distance, which varies between 32 and 35 mm.

HAROLD GRIMSDALE.

(4) **Goulden, Charles (London).—The prognosis in spontaneous and traumatic detachment of the retina.** *Lancet*, October 6, 1934.

(4) In the 21st of the articles contributed by invitation, **Goulden** contributes a short dissertation on the history of modern methods of dealing with detachment of the retina. He gives all credit to Gonin as the pioneer. So far as Moorfields is concerned, the author relates how Gonin's operation was followed by Guist's, in which the sclera is trephined and caustic potash applied to the exposed choroid. This gave 50 per cent. of successes to Gonin's 53 per cent. Guist's operation was followed by that of Larsson, which is the same in principle, but produces the effect on the intact sclera by diathermy. On puncturing the sclera and choroid the subretinal fluid escapes and the retina comes in contact with the patch of choroiditis which has been produced by the diathermy. This method has given 76 per cent. of successes. The prognosis in the case of involvement of the macula is considered and also the case where a quite recent detachment has occurred. The latter gives a good prognosis. Detachment following an operation of extraction of cataract gives a poor prognosis (about 19 per cent.), but after an operation for soft cataract by needling, no results seem to have been obtained.

ERNEST THOMSON.

V.—REFRACTION AND OPTICS

(1) **Lindberg, J. G. (Helsingfors) —Astigmatism with and against the rule in private practice with special reference to astigmatism of the contrary type in the two eyes. (Ueber direkten und inversen Astigmatismus in der Privatpraxis eines Augenarztes mit besonderer Beachtung der Fälle von direktem Astigmatismus im einem Auge und unversem im anderen).** *Acta Ophthal.*, Vol. XI, p. 264, 1933.

(1) **Lindberg** recalls the work of Kodama in questioning the accepted belief that astigmatism with the rule is the more frequent type. The author gives exhaustive analyses of 2,122 cases in his private practice, showing astigmatism of over 0·5 D. These cases constitute 12 per cent. of the total and it appears that astigmatism with the rule is the commoner condition only if cases over 1·0 D. are considered. Amongst the lower error the opposite is true. One point of interest is brought out by a small group of 19 cases in which the astigmatism was in contrary direction in the two eyes; more than half of these cases were myopic and astigmatism against the rule was present in the more defective eye. It is concluded that these cases lend support to the view advanced by Steiger that this type of astigmatism is an acquired condition and develops during the transition from hypermetropia to myopia.

ARNOLD SORSBY.

(2) **Gassowsky, L. N. and Samsonowa, V. G. (Leningrad).—The influence of corneal astigmatism on the degree of the total astigmatism of the eye. (Der Einfluss des Astigmatismus der Hornhautvorderfläche auf den Grad des gesamten Augenastigmatismus).** *Arch. f. Ophthal.*, Vol. CXXXII, p. 297.

(2) The object of this research by **Gassowsky and Samsonowa** was to determine how far the total astigmatism of the eye could be judged by an examination of the astigmatism of the anterior surface of the cornea. They employed the refractometer, supplemented by the subjective test, and the ophthalmometer, and, incidentally, they note that the difference in the direction of the meridians as determined for the corneal and total astigmatism never exceeded 20 degrees.

Out of 300 eyes examined it was found that the total astigmatism of the eye differed from that of the anterior surface of the cornea by not less that 0·5 D. in 167 cases; in some cases this difference amounted to 2 to 3 D.

Of these 167 cases the total astigmatism was less than that of

the cornea in 40 per cent., which would indicate that the corneal astigmatism can be partially neutralized by other factors capable of producing astigmatism.

The authors conclude that the ophthalmometer is not a suitable instrument for measuring the total astigmatism of the eye, because the difference between it and the corneal astigmatism may be too great to be ignored in correcting the ametropia.

THOMAS SNOWBALL.

VI.—MISCELLANEOUS

(1) **Herrenschwand F. von (Innsbruck).—Metastatic fungus infection occurring in an eye ten years after extraction of cataract with heterochromia from cyclitis. (Ueber eine metastatische Pilzinfektion in einem Auge, zehn Jahre nach Extraktion einer Katarakt bei Heterochromie mit Cyclitis).** *Zeitschr. f. Augenheilk.*, Vol. LXXIX, p. 223, 1932.

(1) Herrenschwand records a successful cataract extraction in a case of heterochromia from cyclitis, coming, however, to excision 10 years later on account of ectropion uveae, vitreous haemorrhage and early phthisis bulbi. Histological examination showed infection with either streptothrix or leptothrix (no cultures were made), and as the operation scar was free from infection, the author holds that the infection was metastatic (as in the cases of Fuchs and Verhoeff). He discusses whether the heterochromia and cataract were originally caused by the fungus.

ARNOLD SORSBY.

(2) **Seefelder, R. (Innsbruck).—Rise of tension after capsulotomy and a note on marginal infiltration and marginal abscess of the cornea following operation. (Ueber Drucksteigerung nach Nachstardurschneidung nebst Bemerkungen ueber die nach Augenoperationen auftretenden Randinfiltrate und Randgeschwüre der Hornhaut).** *Zeitschr. f. Augenheilk.*, Vol. LXXIX, p. 212, 1932.

(2) Seefelder draws attention to rise of tension following capsulotomy (which he carries out with the pupil undilated). He describes three varieties.—(1) A mild rise of tension, subsiding within a few days and often passing unobserved; (2) acute glaucoma, generally of short duration and controlled by miotics—he holds this to be caused by entry of vitreous into the anterior chamber; (3) tension with propulsion of the iris, due to strangulation of prolapsed vitreous in the pupil. The author also describes

a case of corneal marginal abscess which occurred consistently after every operation on a patient's eye. He holds that it is not the operation trauma, but the pre- and post-operative procedures which were responsible.

ARNOLD SORSBY.

(3) **Caramazza. (Bologna).—The vitreous in relation to detachment of the retina. (Biomicroscopia del vitreo nel distacco di retina).** ***Rass. Ital. d'Ottal.,*** December, 1932.

(3) **Caramazza** has examined with the slit-lamp and the microscope the vitreous in eyes with detached retina. It is not easy to distinguish the changes due to myopia from those due to detachment and still more difficult to decide whether any given change is the precursor or the consequence of the detachment. There are frequently seen in these cases comparatively large pigmented opacities as well as much smaller, almost dust-like bodies. The larger, the author believes to be cells of the pigment epithelium.

He finds the vitreous notably altered; it is more fluid than normal and there are constantly striated opacities.

The paper is illustrated by a number of drawings representing the various conditions found.

HAROLD GRIMSDALE.

(4) **Bhaduri, B. N. (Calcutta).—Choroideremia.** ***Calcutta Med. Jl.,*** April, 1934.

(4) **Bhaduri** reports the first case of choroideremia seen in India to date, and gives a brief survey of the literature. A Hindu boy, aged 17 years, was seen in July, 1932, complaining of defective vision which became worse at night and dazzling in bright light, while the father stated that the boy often stumbled against objects to either side of him. Symptoms had been noticed since the age of 3 years. The family history was negative, all other members being normal. In a Hindu family there can be no question of consanguinity. The general health of the boy was good and the Wassermann reaction negative. Each eye showed a low degree of compound myopic astigmatism, with corrected vision no better than 6/18. There was a general contraction of the fields of vision to the 20° circle. Ophthalmoscopic examination showed gleaming sclera visible everywhere save at the macular region, which was of normal appearance. The retinal vessels ran in a normal manner over the white fundus, and here and there a few pigmentary patches were seen to obscure the view of the vessels.

The iris was of dark brown colour. A bibliography of 14 items is appended.

R. R. J.

(5) **Kravitz. (Brooklyn).—The vaso-motor system in retinal and cerebral vascular lesions.** *Amer. Jl. of Ophthal.*, August, 1934.

(5) **Kravitz** gives a brief review of the anatomy and physiology of the retinal and cerebral blood vessels and quotes the experimental evidence which shows that these vessels are innervated by the sympathetic nervous system and that the capillaries possess Rouget cells also receiving their nerve supply from the same source. He describes the importance of the vaso-motor system in its relation to the functional integrity of the retina and the brain.

Some interesting cases of spasm of the branches of the central retinal vessels are cited.

H. B. STALLARD.

(6) **Giannoni and Focosi. (Florence).—Haemorrhagic syndromes. Haemorrhagic diathesis and ocular haemorrhage in myopia. (Studi sulle sindromi emorragiche. Diatesi emorragica ed emorragie oculari dei miopi).** *Boll. d'Ocul.*, July, 1934.

(6) Haemorrhages in myopic eyes have not been studied very exactly and their causation is not clear. Most writers have been content to assume that they depend on the anatomical alterations secondary to the myopia; others have suggested that the cause is rather to be sought in some general diathesis. **Giannoni** and **Focosi** consider that many of the subjects come within the group of diseases affecting the venules, which are characterized by a tendency to varicosity, weakness of the vessel walls and lowered tension.

HAROLD GRIMSDALE.

(7) **Stern, H. (Frankfurt).—Comparative investigations of the the fundus appearances in twins. (Vergleichende Untersuchungen des Augenhintergrundes bei Zwillingen).** *Klin. Monatsbl. f. Augenheilk.*, Vol. XC, p. 215, 1933.

(7) **Stern** investigated the fundus appearances in nine uniovular and three binovular twins, employing photographic records for comparison. He found that in the distribution of the vessels there was no symmetry, even of the mirror type. In contrast to the vessels, the structures derived from ectoderm gave considerable symmetry in both types of twins: the form and size of the disc, the physiological cup, the colouration of the fundus were similar. Congenital abnormalities, such as temporal conus, scleral ring, abnormal entry of vessels were similar in twins. The author concludes that the similarity in ectodermic structures does not help to distinguish the uniovular from the binovular twins.

ARNOLD SORSBY.

(8) **Biffis. (Padua).—Topographical researches on the retinal sensibility by means of the pupil reflex. (Ricerche topografiche sulla sensibilità retinica per il riflesso fotomotore della pupilla).** *Ann. di Ottal.*, August, 1934.

(8) The extent of the retina which can give rise after stimulation to the pupil light reflex has been very differently estimated by the various observers who have investigated it. Some have stated that only the region immediately surrounding the macula is able to evoke the reaction, others have allowed a much wider region to be competent. The matter is of some clinical importance since the question of Wernicke's pupil reaction depends on the supposed activity of the peripheral retina. **Biffis** investigating the reflex in patients who showed a large central scotoma has found that up to a distance of least 50° from the centre the retina is capable of evoking the reflex; since the pupil is practically narrowed when light falls very obliquely on the eye, the stimulus required is necessarily greater, the more eccentric the incidence.

HAROLD GRIMSDALE.

(9) **Riegel, E. and Vogelsang, K. (Bonn).—Central scotoma in lesions of the chiasma. (Ueber Zentrales Skotom bei Chiasmaerkrankungen).** *Zeitschr. f. Augenheilk.*, Vol. LXXIX, p. 433, 1933.

(9) **Riegel and Vogelsang** describe six cases of central scotoma in lesions of the chiasma seen during the last two years; five of the patients were aged 16 to 26 years, one, 43 years of age. They hold that this sign is by no means infrequent, so that in cases of retrobulbar neuritis a lesion of the chiasma has to be considered. The six cases are described in detail; one was a pituitary tumour, one a glioma, and four tumours of indefinite nature. The post-mortem findings in two cases are given.

ARNOLD SORSBY.

(10) **Spiratos, S. (Athens).—Ophthalmomyiasis. (De la myiase oculaire).** *Folia Ophthal. Orientalia*, Vol. I, Fasc. 3, p. 311, 1933.

(10) **Spiratos** describes the varieties of flies which provoke myases and discusses five cases of his own in which external ophthalmomyasis was caused by the larvae of oestrus ovis.

He points out the seasonal incidence (in October), the fact that the fly deposits its larvae directly into the conjunctival sac, and that sometimes there is no conjunctival reaction so that the patient is unaware of the larvae.

He describes a method for keeping larvae alive for microscopic examination.

H. B. STALLARD.

(11) **Mazzi. (Parma).—Acetylcholine in quinine amblyopia. (Azione dell'acetilcolina nell'ambliopia ed amaurosi da chinino).** *Arch. di Ottal.*, January-February, 1934.

(11) **Mazzi** has experimented with acetylcholine in cases of dogs made amblyopic by quinine. After an interval of some months, he removed one eye and treated the animal with acetylcholine; then the second eye was removed and examined and compared histologically with the first. No noteworthy differences were found. The author concludes that acetylcholine may have a good effect which is found constantly in these cases, but that it does no good in the late stages. He concludes further that the vascular change is not of primary importance, but that the toxic effect is directed against the nervous elements of the retina and the optic nerve.

HAROLD GRIMSDALE.

(12) **Possenti. (Bari).—The influence of acetylcholine on refractive errors. (Influenza dell'acetilcolin nella emmetropia, nelle ametropie nell'afachia).** *Ann. di Ottal.*, July, 1934.

(12) **Possenti** finds that acetylcholine has little effect on the visual acuity in emmetropia and hypermetropia; what little it has he attributes to its power of diminishing the spasm of the ciliary muscle. He finds a slight improvement in myopes, which is probably due to the same antispastic action. After a mydriatic, acetylcholine has no appreciable effect on the acuity.

HAROLD GRIMSDALE.

(13) **Rees, W. Edmond (Cardiff).—Mikulicz syndrome in association with tuberculosis.** *Lancet*, October 6, 1934.

(13) Although in this article **Rees** speaks about Mikulicz disease and does not mention Heerfordt, so also in the previous article Tait makes mention of Heerfordt and says nothing about Mikulicz. The author states that Thursfield gives a very full review of the whole subject up to 1913 He suggests the following classification:—

1. A congenital, hereditary or familial affection.
2. Mikulicz disease with involvement of the lymphatic apparatus.
3. Mikulicz disease proper.
4. Leukaemia.
5. Tuberculosis.
6. Syphilis.
7. Gout.
8. Sialodochitis fibrinosa.

Recently Garland and Thomson have suggested that the two conditions previously regarded as separate—namely Mikulicz disease and uveo-parotitis—are, in fact, one and the same thing and this report (by Rees) is of a case of Mikulicz syndrome which appears to be of tuberculous aetiology and may be classified as a case of uveo-parotid fever.

ERNEST THOMSON.

BOOK NOTICE

Das Supra-Vestibuläre System bei den Tieren und beim Menschen, mit besonderer Berücksichtigung der Klinik der Blickläh-mungen, der sogen, Stirnhirnataxie, der Zwangsstellungen und der Zwangsbewegungen. By Dr. L. J. J. MUSKENS. Amsterdam: N. V. Noord-Hollandsche Uitgeversmaatschappij. 1934. Price, 25 guilder.

All ophthalmologists and neurologists owe a debt of gratitude to Dutch scientists for the most excellent scientific work which has appeared in the last half-century on the control of eye movements and body posture. Magnus and de Kleyn, Kappers, Brouwer, Winkler, van der Hoeve and others, anatomists, neurologists and ophthalmologists have all contributed by their work to build up our knowledge of the relationship of the vestibular apparatus to ocular movements. Among these workers Muskens must be reckoned as one of the most diligent. Some of his ideas have not always met with general acceptance. In the present beautifully printed volume he brings together under one cover the results of over 40 years research on ocular movements and body positions and their dependence on vestibular function and the integrity of their nervous connections.

So far as I can trace, Muskens' first paper appeared in 1892 on rolling movements in roach (or stickleback) embryoes after injury to the brain stem with a needle. In the ensuing years he has written many papers in various languages on similar subjects. A long experimental paper on the part played by the posterior longitudinal bundle in joining up the vestibular apparatus with oculomotor centres appeared in *Brain*, Vol. XXXVI (1914). A later paper in *Brain*, Vol. XLV (1922) dealt with the vestibular connections with the corpus striatum. The results of these and many other investigations are now available in this one volume which will be invaluable to any ophthalmic surgeon wishing to learn about the control of ocular movements. We have to congratulate both author and publishers on the format and printing of the book.

CORRESPONDENCE

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

SIRS,—The interesting essay on Trachoma in the British Empire by Dr. MacCallan which appeared in the November issue contains reference to the extent of trachoma in Australia. Fifty years ago the principal work of an oculist, certainly in Victoria and South Australia, was the treatment of trachoma, or as it was called in the country "sandy blight."

On September 20, 1909, in the *Intercol. Med. Jl.* of Australia Dr. Orr and I, with the aid of Dr. M. Lynch, published a map of Victoria showing the districts most affected, together with metereological and other details. This map was reproduced in a work of mine the "Twin Ideals," 1918.

It was during the course of that inquiry that one became aware that trachoma was diminishing. The steady disappearance of the disease has become obvious in recent years. In the larger cities new cases are rarely seen and much the same comment applies to the country. My colleagues at the Eye and Ear Hospital, Melbourne, inform me that they do see new cases, but mostly in recent immigrants.

My recently published analysis of the causes of blindness as in the Royal Victorian Institute for the Blind tells the tale in unmistakable fashion (*Med. Jl. of Aust.*, December 30, 1933).

What may be the reason for the practical disappearance of trachoma as a major disease it is difficult to say. The conditions of life have certainly improved, but there was no lack of vigorous and fine physical development 50 years ago.

Elsewhere, both Lieut.-Col. Eason and I have drawn attention to the fact that during the war when British soldiers, to the number of some hundreds of thousands, were in contact with the Egyptians, who are almost universally affected, certainly less than 100 infections took place. Probably a very small number.

There are three diseases which cause much thought and raise biological problems of difficulty, *viz.*, trachoma, gonorrhoeal ophthalmia and leprosy.

Trachoma seems to be, with Anglo Saxons, very feebly contagious. At all events infection is rare. During the war the cases of gonorrhoeal ophthalmia in Egypt were almost negligible, and yet amongst the Turkish prisoners clinical gonorrhoeal ophthalmia was a deadly, contagious and widespread disease.

In Hawaii the Medical Officer at the Kalihi Receiving Station for Leprosy informed us that live organisms had been injected in a few cases and had failed to produce the disease. He added

that he did not know how leprosy was communicated; to which my comment was that I did not know how trachoma arose. In all three diseases there is an unknown factor (as in so many biological problems) which renders their spread possible. Yet we do know that true trachomatous material grafted into the conjunctiva will produce trachoma, and we have always assumed that gonorrhoeal pus would produce gonorrhoeal ophthalmia. At all events whatever be the explanation there is no doubt that trachoma is disappearing in Australia, to my own knowledge in Victoria and from the reports of oculists in other States.

I am, etc.,

JAMES W. BARRETT.

MELBOURNE,
December 27, 1934.

CONJUNCTIVOPLASTY

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

SIRS,—This very brief communication refers to a small but important point in effecting a satisfactory conjunctival support to clean corneal wounds, corneal fistulae, etc., which I do not think is generally known or practised and which I have for a considerable time found most efficacious.

The object of placing a conjunctival flap over a wound of the cornea is, of course, to support by means of a natural bandage the edges of the wound until coapted there is a sealed junction, though not necessarily a firmly healed wound. Now ordinarily the conjunctival flap dissected from the limbus and undermined is brought up or down as the case may require, and its lateral margins are sutured to the conjunctiva which has *not* been separated from the subjacent tissue. The result is that the friable conjunctival membrane allows the stitches to cut through sometimes in 24 hours causing the flap or apron to recede and the wound is no longer sealed or supported. Should this occur the primary object is not achieved. The proper procedure is to incise and slightly undermine the bulbar conjunctiva at the sites where it is desired to attach the free edges of the flap, these are then drawn under and anchored by suture in precisely the same way that the apex of a pterygium is anchored in a transplantation operation.

By this means the conjunctival adhesions maintain the flap in place for a considerably longer time than the usual method. Should the flap not recede after some days (it usually does recede), a snip of the scissors on each side releases it.

Yours faithfully,

W. WALLIS HOARE.

BRISBANE,

January 18, 1935.

NOTES

The W. H. Ross Foundation for the Study and Prevention of Blindness, Edinburgh

THE generosity of Mr. William Henry Ross of Stanmore, Davidsons Mains, has made it possible to establish in Edinburgh an organization with the object of investigating the origin and causes of blindness and utilising the results of such investigation towards its prevention and cure.

Mr. Ross is well known as one of the most successful and most highly esteemed business men in Scotland. A few years ago he lost the sight of both eyes—the one through a comparatively simple accident and the other subsequently through a serious illness. He is now totally blind. Thinking over this experience, he has come to believe that more might be done to preserve the world from the affliction of blindness. Total blindness is seldom curable. When once darkness has descended upon the eyes of the blind, they know that in all but a very few cases it is a darkness that will be with them till the end of their lives; they will never see again. But if the causes of blindness can be discovered and made known there is every hope that it will be possible in the future to check the development at its inception and in many instances prevent the occurrence of one of the greatest afflictions that can well be imagined.

This is the aim of the W. H. Ross Foundation. Mr. Ross has placed in the hands of Trustees a fund of £40,000, the income of which will be applied partly to research work into the causes of blindness and partly to practical measures for its prevention and for the preservation of sight. The Trustees are authorised to confer and co-operate with all bodies and persons engaged in similar work and may delegate their work in whole or in part to a Committee of persons having special knowledge of the problems to

be solved. They are fortunate in having the assistance of an expert Committee, consisting of Dr. Arthur H. H. Sinclair, now President of the Royal College of Surgeons of Edinburgh and consulting surgeon to the Ophthalmic Department of the Royal Infirmary, as also of the honorary staff attached to the Eye Department of that Infirmary.

Dr. Sinclair, 6, Charlotte Square, Edinburgh, is Chairman of the Trustees, and the other original Trustees are Mr. W. H. Fraser, W.S., Edinburgh, and Mr. Henry J. Ross, Dunstane, 4, West Coates, Edinburgh. The present Law Agents and Factors are Fraser, Stodart and Ballingall, W.S., 16, Castle Street, Edinburgh.

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Honour

MR. LESLIE PATON has been invited as a Guest of Honour to attend the meetings of the American Medical Association at Atlantic City, June 10-12.

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Tsinan Ophthalmological Society

THE Tsinan Ophthalmological Society was organised in January, 1935, and its first meeting was held at Cheeloo University School of Medicine on January 30. There was a large attendance. Dr. Eugene Chan, head of the Department of Ophthalmology at Cheeloo, was the chairman. Dr. Chan was formerly a member of the staff of the Wilmer Ophthalmological Institute of Johns Hopkins University and Hospital, Baltimore, Maryland, U.S.A.

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Cours de Perfectionnement, 1935

PROFESSOR TERRIEN announces the annual Cours de Perfectionnement at the ophthalmic clinic of the Hôtel Dieu, to be held in Paris from May 17 to June 17, 1935. As usual the Course is composed of lectures, laboratory and clinical work and ophthalmic surgery. The programme is well filled. The price for the Course has been fixed at 300 francs. Further information may be obtained from Professor Terrien or from the Dean of the Faculty.

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Corrigendum

IN the Review of the Annual Report of the Department of Health of Palestine, 1933, p. 170, the name of Dr. J. Strathearn, C.B.E., should be substituted for Dr. W. E. Thompson, as the consulting ophthalmic surgeon to the Government.

International Anti-trachoma Association

THE following is the programme for the meeting on April 3: Address by the President, Prof. de Grosz. Papers by A. F. MacCallan, J. Jitta, Dr. Tewfik, Prof. Myashita, Dr. Zachert. A discussion will follow the papers. The Secretary General is Dr. F. Wibaut.

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Oxford Ophthalmological Congress

THE XXVth Annual Meeting will be held at Oxford from July 4—6. Sir Harold Gillies will open a discussion on "Plastic Surgery of the Eyelids and Conjunctival Sac." The Doyne Memorial Lecture will be given by Mr. Malcolm Hepburn. Its title is "The Rôle played by the Pigment and Visual Fields in the Diagnosis of Diseases of the Fundus." A short talk on "The Results of Treatment in Retinal Detachment of various types (excluding operative details)" will take place; openers will be allowed ten minutes and other speakers five minutes.

Other papers have been promised by Mr. Tudor Thomas, Dr. Bernard Samuels, Mr. Frederick Ridley and Mr. Arnold Sorsby.

The Master is Mr. C. G. Russ Wood and the Secretary Mr. F. A. Anderson, of Shrewsbury.

FUTURE ARRANGEMENTS

1935

April 4—6.—Ophthalmological Society of the United Kingdom (Annual Congress).

April 5.—Midland Ophthalmological Society, at Nottingham Eye Infirmary.

April 12.—North of England Ophthalmological Society, at Sheffield.

May 31.—Midland Ophthalmological Society, at Bath Eye Infirmary (joint meeting with South-Western Ophthalmological Society).

June 14.—Section of Ophthalmology, Royal Society of Medicine (Annual Meeting).

July 4, 5 and 6.—Oxford Ophthalmological Congress, at Oxford.

July 29—*August* 2.—Second International Neurological Congress, in London.

October 1.—Midland Ophthalmological Society, at Birmingham Eye Hospital.

December 3.—Midland Ophthalmological Society, at Birmingham Eye Hospital.

CONTEMPORARY OPHTHALMIC LITERATURE

American Journal of Ophthalmology. *February, 1935.*

TRONCOSO and REESE. Gonioscopic findings after Elliot's operation.
BROWN and POST. Social service in ophthalmology.
O'BRIEN and LEINFELDER. Unilateral exophthalmos.
JULIANELLE and HARRISON. Studies on the infectivity of trachoma.
BERENS. A clinical ophthalmic ergograph.
ALVARO. Squint measurement with Priestley Smith's improved method.
O'CONNOR. Peripheral iridotomy (Curran) in glaucoma.
BENDER. Simultaneous closure of all the the central retinal vessels.
PRANGEN. Surgery of the rectus muscles of the eye: selection of operative procedures by differential diagnosis.

Annales d'Oculistique. *February, 1935.*

POULARD. Entropion originating at the external angle. Surgical treatment.
VOGT. Ocular senescence.
WEIL and MORAX. Transitory visual troubles accompanying Biermer's anaemia without haemorrhage. Transfusion.
BLAGOVECHENSKY and MORGENSTERN. Contribution to the study of intra-dural gliomata of the optic nerve.
DUBOIS. Glaucoma or ocular high tension in a pregnant woman. Disappearance of the trouble after spontaneous miscarriage.
GABRIÉLIDÈS and JOANNIDÈS. Isolation of a "coryné-bacterie" atypical of the human conjunctiva.

Archives d'Ophtalmologie. *February, 1935.*

TEULIÈRES and BEAUVIEUX. Histological study of the normal human eye subjected to the action of atropine and pilocarpine.
NORDMANN. Physico-chemical studies on the normal and pathological crystalline lens.
ROSTKOWSKI. Forceps for Denig's operation.

Revue d'Optique. *September, 1934.*

HOMÈS. Contribution to the problem of the primary standard of intensity of light.
BOUTARIC. Remarks on the dispersive properties of combinations of prisms.

Klinische Monatsblätter für Augenheilkunde. *February, 1935.*

WÖLFFLIN. Acuteness of vision and determination of perception of light.
ENGELKING. Serious ophthalmic X-ray injuries of the foetus after irradiation of the father.
POOS. Closure of eyelids and intra-ocular pressure.
WIEDERSHEIM. Rodent ulcers.
JAENSCH. Ptosis operation.
BUSCHKE. Deep corneal haemorrhage along with sclero-keratitis.
MACHEMER. Concerning the treatment of retinal detachment by means of electrolysis.
BUSACCA. Trachomatous avascular keratitis.
NOWKIRISCHKY. A new table for noting down the intra-ocular pressure.

Annali di Ottalmologia e Clinica Oculistica. *January, 1935.*

BIFFIS. Contribution to the knowledge of the curvature of the sclera in the anterior segment of the eye.
SABA. Cerebral echinococcus with ocular complications.
CACIOPPO. Cataract operation the share of physical and anatomical characteristics.
BRACCI-TORSI. Clinical and histological contribution to cysts of the iris.

Bollettino d'Oculistica. *January, 1935.*

BIETTI. Vitamin C (ascorbutic acid) in the ocular fluids and tissues: its relation with the biology of the lens.
STRAMPELLI. Biomicroscopy and histology of cataract with polarized light.
HESKY. Clinical case of spontaneous hole in the retina in a myopic eye without detachment, with complete detachment of the vitreous. Consideration of the part this plays in the conception of retinal detachment.

Rassegna Italiana d'Ottalmologia. *November-December, 1934.*

BELLAVIA. Ocular affections of dental origin with particular regard to those interpretable by the mechanism of focal infection.
SALA. Band opacity and guttate cornea.
CARAMAZZA. The biological proof in some ocular lesions suspected of being tuberculous.
FONTANA. Biomicroscopical study of the sclero-corneal limbus in some ocular affections.
VENCO and CASTELLI. Clinical observations on the use of ether-benzyl-cinnamon in the treatment of trachoma.
DUC. Solitary tubercle at the site corresponding to the nuclei of the third pair of cranial nerves.
AGNELLO. Primary leprous iritis.
GALLENGA. Ophthalmoscopic observations of the formation and of the spontaneous recovery of retinal detachment.

Archivos de Oftalmologia Hispano-Americanos. *January, 1935.*

DAMEL and VILLEGAS. Neuroma of the orbit.
BARRIERE. Conjunctivitis and endogenous gonorrheal keratitis.
ORTIZ. Salicyl-iodine ionization and illustration of its value for corneal opacities.

Revista Oto-Neuro-Oftalmologica. *January, 1935.*

PAVIA and VICTORIA. Oedema of the papilla and varicella.
ALVARO. Ocular anaesthesia.

Revista Cubana de Oto-Neuro-Oftalmiatria. *July-October, 1934.*

BERENS, CONNOLLY and CHAPMAN. Focal infection in diseases of the eyes.
HERNANDEZ. Observations on the therapeutic value of ophthalmic diathermy.
ESTEBAN. Restoration of the conjunctival sac *ex vacuo*.

Ophthalmologica. *January, 1935.*

COSTI. Biomicroscopy of trachoma.
UNAMUNO. Radiograph of the lacrymal passages as preparatory assistance for dacryocystorhinostomy.
LOPEZ. Some aspects of the tonsil as a focus of ocular infection.